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Engineering News-Record

A Consolidation of Engineering News and Engineering Record

McGRAW-HILL PUBLISHING COMPANY, INC.

April 5, 1917

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Engineering News-Record

A CONSOLIDATION OF ENGINEERING NEWS AND ENGINEERING RECORD

A Weekly Journal Devoted to Civil Engineering and Contracting

PUBLISHED BY MCGRAW-HILL PUBLISHING COMPANY, INC.

Volume 78 NEW YORK, THURSDAY, APRIL 5, 1917 Number 1

The Technical Journal as an Institution

The Engineering and the Business Periodical Must Be the Coördinator of Its Field and Must Be Backed by a Stable, Competent, Hard-Hitting Organization

By JAMES H. McGRAW

President, McGraw-Hill Publishing Company, Inc.

THE primary and obvious function of a technical journal is to report and interpret facts and events. Another function and one only little less obvious is that of looking into the future and indicating the direction in which the profession or industry is going. This means leadership, and manifestly imposes a grave responsibility, for such forecasts may have a profound influence on future developments. Complementary to this function of sensing and interpreting the trend, is the duty of indicating in what direction danger lies.

These functions could be discussed in great detail, and with much profit. The purpose here, however, is to view technical and business publications broadly, and it is necessary, therefore, to pass over briefly these essentials because they are more obvious than other functions and factors which enter into the making of an engineering periodical.

Tying the Industry Together

An important mission of a great periodical, and one which is less clearly realized than the interpretative and news-reporting functions, is that of tying its industry together. I say "industry" advisedly, even though I realize the basic professional character of a paper such as the *Engineering News-Record*. I do not believe that an engineering journal can properly fill its mission if it neglects the commercial interests upon which the execution of the engineer's designs are dependent. That is why I have used the word "industry." The constructive profession, if I may so designate engineering, is not, as are law and medicine, teaching and the ministry, complete within itself. The engineer may design, but his work is for naught unless the contractor and the manufacturer of materials and equipment collaborate with him.

Consider for a moment the influence that the commercial interests have had on the development of civil engineering. Unless they had poured out millions in experimentation we should still have wooden bridges, hand-mixed concrete, crude and expensive methods of excavation. It is true that these sums have been spent in experimentation in the hope of reaping a profit from the discoveries and improvements. The commercial motive, however, does not alter the fact that the manufacturers have been necessary collaborators in engineering development and that on them still largely depends the cheapening of processes which will open new fields for engineering enterprise.

To my mind no journal is adequately serving its field unless it helps to bring all the divisions of the field into one great unity. It breaks down prejudices and, by accentuating the mutuality of interests, prevents working at cross purposes. It is a great coördinator, a great unifying force.

In the civil engineering field, for example, there have been antagonisms between engineer and contractor. The technical journals have helped to break these down. Then there have been developments in equipment and materials which were not sound. When criticized the manufacturers have fought back. They have failed to recognize that their interests could be truly served only when the entire group—engineers and contractors included—was benefited.

Organization Back of the Journal

Manifestly no mere aggregation of printing presses, of skilled typographers, of writers of phrases can perform these interpretative and unifying functions. There must be authority behind the printed words. The industry must know that those who publish the journal have technical knowledge, close contact with the field, means for getting all the facts, sound judgment, clear and uplifting vision, unfaltering courage in speaking their convictions. In a word, the industry must have confidence in the journal's integrity and ability. And that confidence must not be for the present only. The readers must know that the journal will stand firm for the right no matter what the coming vicissitudes, no matter what the future problems. Such confidence can result only from years of unselfish, unswerving service.

In sum, the paper must be above personalities, above editors and publishers—*it must be an institution*. Its principles must be so grounded in truth that they cannot be changed, its policies so well crystallized that they appear unconsciously in every issue and impress themselves on the reader, its traditions so entwined with the interests of its readers that it cannot without an unthinkable shock divorce itself from their service.

It must go on like a great university. With all the vicissitudes that have come over France, for example, the University of Paris still stands. In our own country, the great universities go on from generation to generation, leading the thought of the country, retaining the confidence of the people. They are in the truest sense institutions.

So, too, are the great technical journals institutions. Despite changes in editors or ownership, or both, such journals as *Engineering*, of London, *Le Genie Civil*, *Iron Age*, *Railway Age-Gazette*, *Engineering Record* and *Engineering News* have gone on consistently serving their respective clienteles.

Engineering News-Record

It is as an institution—an institution of great virility and influence—that I conceive of the future *Engineering News-Record*. To dedicate the new journal to the service of the profession would be merely a rededication and in a measure presumptuous, for it has already been dedicated to that service by the lives and efforts of the able men who have made *Engineering News* and the *Engineering Record*. The traditions that they have built and that the present staffs have inherited and strengthened will be carried into the new paper. It will have all the virility and courage of its worthy predecessors, the combined strength of two great engineering journals. Their history is a full guarantee that the new paper can be counted on to serve the engineer, the contractor, and the collaborating manufacturers of equipment and materials fearlessly, with an eye single to the best interests of the entire group. Alone, they wrote themselves into American engineering development. Combined, they will be a still greater factor in helping to carry that development to higher and higher planes.

Development of the "Engineering Record"

Founded in 1877 as the "Plumber and Sanitary Engineer," It Broadened Its Field To Cover the Whole of Civil Engineering and Contracting

By E. J. MEHREN

Vice President and General Manager, McGraw-Hill Publishing Co., Inc., formerly Editor of the "Engineering Record"

IT IS a high privilege to be permitted upon the termination of the separate existence of the *Engineering Record* to tell the story of its development and to pay a well-deserved tribute to those who founded and built the structure which, in later years, has been intrusted to my care.

Those who have come to know the *Engineering Record* only in recent years can have no conception of the very remarkable early history of the paper. Founded by a broad-minded man and conducted for the sole purpose of rendering a much-needed service to the public, it received at the very start the support and assistance of a group of intellectual giants whose prestige enabled the paper in a few years to write far-reaching laws on the statute books of New York State. And these statutes, forming the model for the rest of the country, have had an influence throughout the land.

The Founder

Henry C. Meyer, the founder of the *Engineering Record*, was a manufacturer of plumbing supplies. A man of his vision could not look on his business from a narrow point of view. He was, to his mind, not merely manufacturing plumbing appliances; he was serving the public by making products essential to the conservation of public health. Studying his work from that angle, he realized that there was need for better recognition of the correct principles of the design of sanitary apparatus and for wider knowledge of methods of conserving the public health. There was no medium through which this knowledge could be spread, no forum where experts could discuss sanitary questions. Regardless, therefore, of whether the venture would pay or not, he started the *Plumber and Sanitary Engineer* in December, 1877.

The paper was issued monthly, and its avowed purpose was to inform the public and practitioners on questions of drainage, water-supply, heating and lighting. Charles F. Wingate, an excellent newspaper man, but without a broad technical education, was appointed editor. Major Meyer's plan, however, was not to publish the journal solely by his own efforts and those of Mr. Wingate. He had planned to interest in the enterprise the ablest men in the specialties that the journal proposed to cover. From the start, therefore, we find among the contributors and advisers such men as Dr. John S. Billings, U. S. A., president of the National Board of Health, director of the United States Army Medical Museum and Library, and later director of the New York Public Library; Prof. Charles F. Chandler, professor of chemistry at Columbia University and at that time president of the New York City Board of Health; Edward S. Philbrick, of Boston, civil and sanitary engineer; J. J. R. Croes, hydraulic engineer and one-time president of the American Society of Civil Engineers; T. O'Conor Sloan, Ph.D., specialist in lighting problems; Prof. Henry Morton, Ph.D., president of Stevens Institute of Technology; Robert Briggs, mechanical engineer, father of the Briggs system of screw threads; Col. George E. Waring, Jr., and William E. Worthen, hydraulic engineer. These men worked with an admirable earnestness that quickly produced results.

Tenement-House Design

One of the first problems that Major Meyer vigorously attacked through the new paper was the tenement-house condition in New York City. There were then practically no restrictions on tenement-house design, and the tenements were as a rule breeding places for disease. In order to interest architects in the health side of the problem, and also secure the coöperation of sanitary engineers, a competition was arranged in 1879 for plans for improved tenements. The standing that the new journal in just a little more than a year had attained is shown by the eminence of the judges of the competition—Rev. Henry C. Potter, D.D., later bishop of New York; Rev. John Hall, D.D.; James Renwick, the famous architect; Prof. Charles F. Chandler; and Robert Hoe, the well-known printing-press manufacturer.

The results of the competition passed all expectations. Over 200 designs were received and were publicly exhibited for two weeks. The newspapers gave the competition much space, and the agitation that followed culminated in the New York State Tenement House act of 1879.

The Plumber
AND
SANITARY ENGINEER.
WATER SUPPLY, DRAINAGE, HEATING AND LIGHTING.

Vol. I. No. 1. NEW YORK, DECEMBER, 1877. Terms, $1.50 per Year. SINGLE COPIES, 15 Cents.

THE PLUMBER and Sanitary Engineer.

CHAS. F. WINGATE, Editor.

PUBLISHED MONTHLY, AT $1.50 PER YEAR, POSTAGE PAID.

Application for advertising and all communications should be addressed to

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INTRODUCTION.

The need of a first-class journal devoted to the interests of the business of water supply, drainage, heating and lighting has long been felt. To fill the existing vacancy is the object of this journal, as its name indicates. It aims to make every plumber a sanitary engineer. Thus is the title given to members of this trade abroad, and it well describes their province. There is need of a higher standard of excellence among them. Too many plumbers have no real practical capacity—they might well be called mere joint wipers. A true plumber should be something more, and we shall strive to bring about this result by making public the best current information bearing upon this branch of industry. We shall endeavor to stimulate members of the trade to study and improve in their particular line of business, both as a matter of duty and of interest. An unjust odium has been cast upon plumbers, gas and steam fitters, owing to the lack of skill on the part of certain incapable workmen.

The public should know that there are as intelligent and as honorable men in this as in any other line of business, and that if they will only discriminate they can get first-class work at reasonable rates, and from intelligent parties.

THE PLUMBER will contain the fullest and latest information on all matters pertaining to the Plumbing, Gas and Steam Fitting Trade.

This will be supplemented by frank and impartial discussions of timely topics, such as practically effect the trade, including everything relating to the water supply, lighting, ventilation and sanitary regulation of buildings. The ablest contributors will be secured and no pains will be spared to make it a first-class periodical, such as will deserve and therefore receive the support not only of the trade, but of the community at large. Communications of every kind are invited. This journal represents and will cater to no personal or class interest, but will speak for the whole trade.

A CASE IN POINT.

If you had a child afflicted with a serious malady, would ... would agree ... contract with ... for the least a ... the only cons ... in making you ... If you had ... you employ ... might do it ... shoer with a ... say these qu ... fairly illustrat ... day in the ma ... If any plo ... whether it is t ... pipe, remove ... are too apt to go out, in search of a man "who works himself," supposing he will therefore do it for less money. Responsibility, experience, intelligence, count for nothing; the sole consideration is who will do it cheapest? That is the great point, and thus through the lunacy of the householder, and the ignorance of the botch who claims to be a plumber, the lives and health of families are put in peril. You say this is an exaggerated picture; let us therefore simply state a case that came under our notice within the past two weeks.

In an elegant house on a prominent street, there have for some time past been frequent complaints of bad smells arising from the cellar; a so called "plumber" was sent for, who came and found the cement bottom of the cellar damp and crumbling away. He prescribed more cement, plastered it over, sent, and collected his bill; but soon was sent for again, and again prescribed the same remedy. Finally some member of the family was taken ill, the stench coming out of the hot air registers becoming unbearable. Then, and not till then did the house-holder inquire where he could get an intelligent plumber; one was recommended, for they are to be found, and in this city too. He went into the cellar, where he found a portable hot air furnace. The cellar smelt like a privy; he noticed the crumbling and damp cement, and with his foot removed enough to expose the main waste pipe from the house which came down inside the cellar wall and stopped within a few inches of an open brick drain and all this less than twelve inches from the surface. The contents of the waste pipes had thoroughly saturated this cellar bottom and the rear part of this Madison Avenue cellar was nothing more nor less than a cesspool; while the inmate air was heated by the furnace and sent throughout the house. The matter has at last been properly attended to, and we trust none of the occupants will die from the effects of this stupidly bad plumbing in a first-class house. We believe there ... New York ... our houses ... Discrimin... owners and ... tect parties ... remedy.

1877
The beginning of *The Engineering Record*—a monthly.

...OLISH.
... to build a ... his plans ... rect is sup... understand ... perience is ... contract...

IN 1877 THE PUBLICATION WAS A MONTHLY

It is interesting to note that, as an incident to this competition, Major Meyer set the standards which have since applied in all reputable architectural competitions. Previous to that time, such competitions had been in bad repute. The principles established were that expert professional men should be on the committee of award, that the plans should be submitted anonymously and that precise rules should be laid down as to the methods of rendering the drawings, so that shading and coloring intended to influence unduly the layman were prohibited.

The following year another competition was held, the subject being a public school. At the same time the journal exercised its influence in favor of the adoption of a proper plumbing code and succeeded in having the New York legislature require of all buildings in New York and Brooklyn the plumbing standards that had been laid down in the *Plumber and Sanitary Engineer* fully three years before. Substantially, these requirements are in the plumbing regulations of every city in the United States, modified, of course, in recent years as practice has developed.

Notable Contributions

We might go on setting forth in detail the other notable public efforts in which the journal engaged. There was, for example, the influence that the paper exercised in helping to secure legislation for heating railway cars by steam, thus abolishing the car stove; and the preparation by Major Meyer of an exhibition of American sanitary practice, which was shown at the International Health Exhibition in London and was completely financed by the paper.

Among the notable articles in the first few years, all of a serial nature, were those by Edward S. Philbrick on water-supply and sewerage problems; by Col. George E. Waring, Jr., on the reduction of the mortality rate in English cities, due to the introduction of sewerage systems; on steam heating, by Robert Briggs; and later another by W. J. Baldwin; by Prof. W. H. Burr, on buildings of the steel-skeleton type; on road building (the results of a competition in which the awards were made by Edward P. North, Francis Collingwood and James Owen); on methods of preventing water waste; on notable European bridges and bridge approaches; and on European paving practice.

Growth of the Paper

These valued services to the profession were not without their reward. Engineers quickly recognized the authoritative character of the journal and its high purpose. In less than two years it was found advisable to change the paper to a semi-monthly, and on Dec. 1, 1881, to a weekly. The word *Plumber* in the title was early subordinated and the name *Sanitary Engineer* formally adopted in 1880. In 1887 the name was changed to the *Engineering and Building Record*, thus indicating the expansion in the scope of the journal. For some years it had been going beyond its field of sanitation (with which building work was naturally closely connected) and had been rendering a service to civil engineers generally. This service continued to be of increasing value and scope, and in 1890 the name by which the journal has been best known, the *Engineering Record*, was adopted.

THE SANITARY ENGINEER
PUBLIC HEALTH · DRAINAGE · WATER SUPPLY · VENTILATION · HEATING · LIGHTING

VOLUME 8. NUMBER 1. NEW YORK, DECEMBER 1, 1881. SINGLE COPIES, 10 CENTS.

THE SANITARY ENGINEER
Published every Thursday,
at 140 Nassau St., New York.
TERMS, $5 PER YEAR, IN ADVANCE.
Foreign Postage $1 per year additional.

OFFICE IN GREAT BRITAIN,
26 Charles Cross, London.
E. & F. N. SPON, Agents.
TERMS 20 sh. PER YEAR, IN ADVANCE.
Foreign Postage $1 per year additional.

The columns of this journal open all technical subjects on either progressive or sanitary principles. Its aim is to enlighten the public concerning Public Health, House Drainage, Water Supply, Sewerage, Ventilation, Heating and Lighting.

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ANNOUNCEMENT

Four years ago this journal started as a sixteen page monthly. Eighteen months after, it became a twenty page semi-monthly. As such it has grown to thirty-two pages, and the present issue is thirty-six pages. The pressure on our reading and advertising columns, and the interest manifested in the topics we discuss is such that we deem this, the beginning of our fifth volume, an auspicious time to make THE SANITARY ENGINEER a weekly paper. For the present it will contain twenty pages, and will be issued every Thursday, the subscription price remaining unchanged.

In making this announcement, we desire to make grateful acknowledgment to our contemporaries of the press for their generous recognition of our efforts during the whole period of our existence.

At this time it may be well to remind our readers of the progress which has been made during the past year in sanitary science and engineering. The most important part of this progress has been in the education of the public as to the need for, and possibility of preventing sickness and death; and in this work we think we can truthfully say that this journal has taken a prominent part. It is the most important, because an educated and intelligent public opinion is essential to the success of all hygienic measures, for nearly all of these involve a certain amount of trouble and expense. People are now beginning to understand the value of pure water, the importance of a disposing of excreta and garbage so as to insure that the air we breathe shall be unpolluted by the products of d... that disease ca... not only to the ... munity. Thus ... the parents of ... patient sufferer) ... the health of ... the physicians ... in prevention a... This educat... more exact kn... and the demon... the suspicion ... being fostered ... going on; ... extent of disea... more complete ... overcrowding, polluted water, and contagia ... becoming better known, and an epidemic no longer considered to be an unavoidable dispensation of Providence, any more than a great fire, or a railway collision. And so fast as the causes of disease are understood, the ingenuity and technical skill of the nineteenth century is applied to providing the means of avoiding or destroying these causes. The announcement by Pasteur, or Koch, or Burdon-Sanderson, of the discovery of a new fact in the life history of some minute and apparently insignificant organism, at once becomes a basis for means of disinfection provided by the chemist or engineer, or for legislation in preventing the spread of disease.

Many pseudo discoveries, false facts, and absurd theories, with regard to sanitation are now being announced, which to a superficial observer tend to bring discredit on the whole subject; but there is nevertheless a real advance—an advance which is clearly shown in the volume of THE SANITARY ENGINEER which has just been completed. The demands upon this journal for reliable information upon sanitary matters are manifold, and to meet them it has been necessary to enlarge it, and to materially increase its staff of skilled contributors.

We enter upon the new volume with the determination that it shall continue to be a reliable work of reference to physicians, architects, engineers, sanitarians, legislators, and householders generally, and we shall be glad to receive contributions, queries, criticisms, or suggestions with regard to any matters which come within its scope.

MALARIA

Two reports upon malarial fevers have recently appeared which have a more than ordinary interest, not so much because they announce important discoveries as because they are the results of careful investigation on the part of trained observers, and while negativing some modern European theories upon this subject, seem to point out the direction in which further research should be made. The first of these documents is a Report to the National Board of Health by Surgeon G. M. Sternberg, U. S. ... some experimental investigations made ... of malaria... upon the ... one of Dr. ... and com... a detail... topograph... of no diff... elsewhere, ... by Klebs ... briefly that ... that these ... ugh on the ... living in his ... ...ould not be ... the active agent in the causation of malarial fever as such.

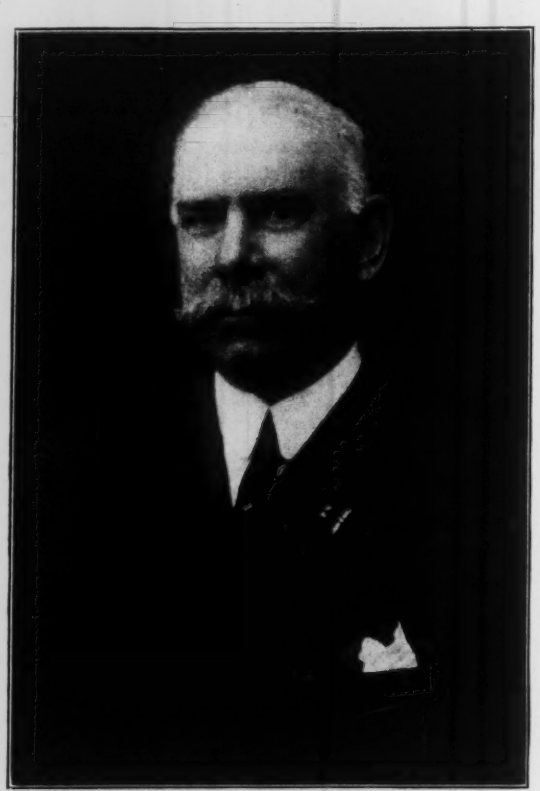
The second Report referred to above is one on Intermittent fever in Massachusetts, made by

1881
The second stage of *The Engineering Record*—a weekly

THE "SANITARY ENGINEER," WHEN "ENGINEERING RECORD" BECAME A WEEKLY, IN 1881

Mr. Wingate continued as editor of the paper for four years; upon his retirement Major Meyer himself assumed charge of the editorial department. He gradually strengthened its permanent editorial staff, among those employed being his son, Henry C. Meyer, Jr., who looked after the mechanical-engineering section, an important branch of the paper at that time; John M. Goodell, who had received his early editorial training under Arthur M. Wellington, the well-known editor of *Engineering News;* and Frank W. Skinner, who prepared descriptive articles on building construction, bridges, foundations and contractors' methods. Mr. Goodell initially took charge of the municipal-engineering features of the journal, but gradually his scope and authority were widened until late in the nineties he was in charge of the paper editorially.

The "Engineering Record's" Founder, Who Began the Publication as the "Plumber and Sanitary Engineer"



MAJOR HENRY C. MEYER

In 1901 he resigned because of ill health. He was succeeded as editor by Alfred D. Flinn, now deputy chief engineer of the New York Board of Water-Supply.

After having conducted the paper for 25 years, keeping it true always to his original ideal of service to the public and the engineers, Major Meyer, desiring to retire from business, sold the paper to James H. McGraw, who in turn transferred the property to the McGraw Publishing Co. The transfer was made in November, 1902.

Shortly after the McGraw Publishing Co. bought the paper, Mr. Goodell was made editor. With the combination of a sound constructive policy and Mr. McGraw's vision as to the possibilities for service to the civil engineer and the contractor, the journal grew with surprising rapidity. There were but 4000 subscribers on the list when the paper was purchased. Now it reaches over 20,000 engineers and contractors weekly.

It became apparent shortly after Mr. McGraw bought the paper that it was not possible in a single journal to serve adequately the civil-engineering and contracting field and, in addition, cover heating and ventilation and building power plants, specialties in which the journal had grown to be the leading authority. Despite its grip on the latter field, therefore, and holding to the ideal of an exceptional service to readers, the publishers deliberately turned their backs on their past accomplishments in the power field and decided to devote the paper entirely to civil engineering and contracting.

IMPORTANCE OF CONSTRUCTION

While many factors contributed to the paper's development after its purchase by Mr. McGraw, including Mr. McGraw's able counsel and assistance and Mr. Goodell's remarkable grasp of the engineering field and his wide personal acquaintance and influence, one policy stands out clearly as an important element—namely, the broad conception that the new journal had of the essential unity between engineering and construction. There seemed in the earlier days to be an opinion that engineers stood very much by themselves and that the construction part of their work, save on structures of the greatest importance, was a secondary matter. The *Engineering Record* took the stand that construction needs as much attention as design, and consequently devoted much space to field methods. It is not claiming too much to say that the present recognition by engineers of the importance of construction methods has been due in no small part to the persistent hammering home of this idea through the reading pages of the *Enginering Record.*

Mr. Goodell continued to conduct the paper through the days of its greatest development, resigning to devote himself to other interests in 1912.

MR. GOODELL'S PART

While to Major Meyer is due the broad foundation on which the *Engineering Record* has builded, to Mr. Goodell must be attributed that attention to details, that accuracy, that broad conception of the unity of engineering and construction, that careful attention to every phase of the engineer's work, which are so evident in the *Engineering Record* of today. Moreover, he left behind him a staff thoroughly trained for continuing his work. The men who have carried the responsibility of producing the *Engineering Record* in the last four years have all been products of Mr. Goodell's training.

The writer assumed editorial direction of the paper in September, 1912, with the determination to pass on unsullied, when the time for his retirement should come, the ideals that had been inherited from Major Meyer and the preceding editor. Without sacrificing any of the standards of the past, the aim in recent years has been to build up the news section of the paper, to boil down the articles to the smallest compass consistent with the value of the material, to present articles interestingly and to deal vigorously with the issues confronting engineers and contractors.

To what extent we have succeeded in carrying out our ideas, the readers must themselves judge. Certain it is that no staff could have worked together with more enthusiasm than did that of the *Engineering Record*. Each member made his personality felt through the pages of the paper, so that it can truly be said to have been a composite product. The consistent unity throughout all the departments is the best evidence of the harmony and coöperation that prevailed.

Finally, the staff in all its proposals for betterments had the hearty support of the advertising and circulation departments, of the company as a whole and, above all, of Mr. McGraw. He never failed to back up all worth-while improvements with both financial and moral support. With such help the paper was bound to succeed, and now, as it passes from its separate existence, we make bold to say that engineers and contractors will be glad to testify that it has succeeded.

The "Engineering Record" Under E. J. Mehren's Editorship

By ROBERT K. TOMLIN, JR.
Managing Editor, "Engineering News-Record"

IT IS characteristic of Mr. Mehren that in writing the foregoing history of the *Engineering Record* he should have given scant notice to his own part, as editor, in the development of that journal. His was the part of the constructor who, building upon the solid foundation laid by other hands, carries the edifice upward to new heights.

Mr. Mehren joined the staff of the *Record* as an associate editor in 1907, after he had graduated from the civil-engineering course at the University of Illinois in 1906 and spent five months on location of the Puget Sound extension of the Chicago, Milwaukee & St. Paul Ry. After four years of editorial work he resigned to become manager of the Emerson Co., efficiency engineers, of New York City. Here he remained until 1912, when the resignation of John M. Goodell left vacant the editorship of the *Engineering Record*, to which Mr. Mehren, a young man for so important a post, was appointed in 1913.

His selection was a happy one. Well equipped by training and temperament for the task in hand, he entered whole-soul into his work. His leadership was an inspiration to the members of his staff, and he built up around him a closely knit organization in which loyalty and teamwork became the slogans. His enthusiasm, his keen insight into the problems of the technical journal and its readers, and his unwavering faith in the engineer were soon reflected in the pages of the paper. Its influence extended rapidly, until it occupied a position in the front rank of similar publications.

Always a clear thinker and a forceful writer, Mr. Mehren made the editorial pages one of the strongest features of the *Engineering Record*. He never dodged an issue, but grappled with it. Turning his attention to the news section of the paper, he gave the readers a service they had never before enjoyed. His next effort was in enhancing the interest of the *Record's* articles without detracting from their technical value. He demanded from his associate editors and contributors not merely the facts, but the facts arranged in an orderly and easily understandable manner. In other words, his aim was to produce a readable paper. Not content with raising the journal's literary standards, he gave it a new, more readable and more pleasing typographical dress.

For years the *Engineering Record* had sold its front cover as advertising space, but Mr. Mehren saw an opportunity of benefiting the reader by changing this policy; he was largely instrumental in inducing the executive heads of the McGraw Publishing Co., Inc., to sacrifice the revenue derived from the sale of the front cover in order to give the subscribers, each week, a news picture of some notable engineering work.

"Engineering Record's" Last Editor—Now Vice President and General Manager, McGraw-Hill Publishing Company, Inc.

E. J. MEHREN

While insisting upon an adequate treatment of technical subjects in each issue, he gave to his readers much that had to do with the human side of engineering. He has ever been a staunch defender of the best interests of the profession and a believer in a bigger future for its members.

In estimating Mr. Mehren's contribution to American engineering journalism, I prefer to credit him with the conception and development of what I shall call a professional—not merely a technical—paper. In other words, without minimizing their importance in the day's work, he looked beyond a horizon of stress diagrams and mathematical equations and saw the engineer, not merely as a highly developed thinking machine, but as a human being, a potential force in public affairs, a man to whom Destiny will soon intrust a larger share of the world's work.

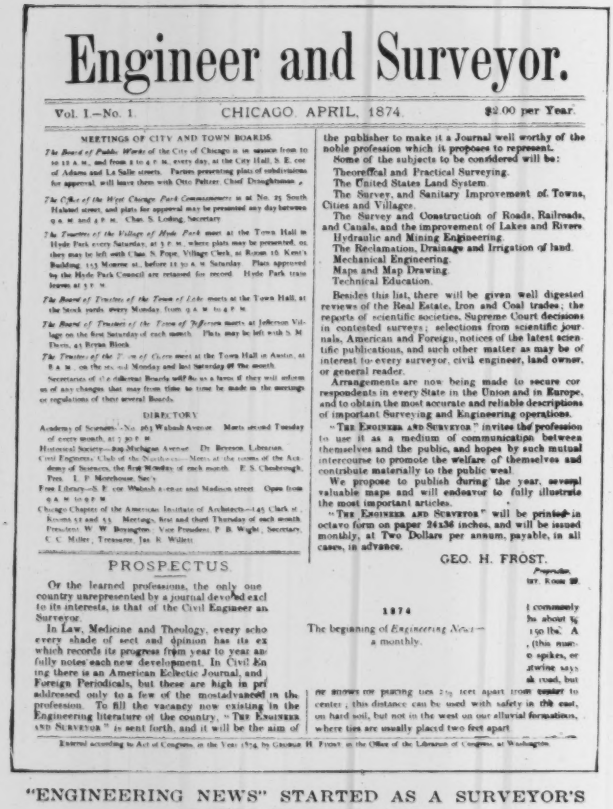
The Story of "Engineering News"

Journal Founded 43 Years Ago by George H. Frost—Originally Intended for Land Surveyors—Paper Thrives Under Wellington

By CHARLES WHITING BAKER
Editor in Chief, "Engineering News-Record"

IT WILL be 43 years on Apr. 13 since the first number of *Engineering News* was published. Its founder, George H. Frost, whose death occurred only three weeks ago, was in the early '70's a Chicago land surveyor. The story of his life was briefly told in *Engineering News* of Mar. 22. He had graduated at McGill University, Montreal, in 1860, from the very primitive course in civil engineering that the institution offered at that day, and after half a dozen years' work, mostly in land surveying, had opened an office on his own account for land surveying in Chicago.

At that early day, plotting subdivisions in the rapidly growing cities of the West was a fairly good business for a civil engineer, and aside from the very active field of railway location and construction, there were few other opportunities for civil-engineering work. The great field of municipal and sanitary engineering was then almost entirely undeveloped. City governments throughout the country were notoriously corrupt and had little use for civil engineers except in the capacity of surveyors. In bridge construction the work of the engineer was only beginning to be appreciated. Building design and construction were entirely in the hands of the architects.



Engineer and Surveyor.

Vol. I.—No. 1. CHICAGO, APRIL, 1874. $2.00 per Year.

MEETINGS OF CITY AND TOWN BOARDS.

The Board of Public Works of the City of Chicago is in session from to 10 A. M., and from 1 to 4 P. M. every day, at the City Hall, S. E. cor of Adams and La Salle streets. Parties presenting plats of subdivisions for approval, will leave them with Otto Peltzer, Chief Draughtsman.

The Office of the West Chicago Park Commissioners is at No. 25 South Halsted street, and plats for approval may be presented any day between 9 A. M. and 4 P. M. Chas. S. Loding, Secretary.

The Trustees of the Village of Hyde Park meet at the Town Hall in Hyde Park every Saturday, at 3 P. M., where plats may be presented, or they may be left with Chas. S. Pope, Village Clerk, at Room 16 Kent's Building, 115 Monroe st., before 12 30 A. M. Saturday. Plats approved by the Hyde Park Council are returned for record. Hyde Park trains leave at 3 P. M.

The Board of Trustees of the Town of Lake meets at the Town Hall, at the Stock yards, every Monday, from 9 A. M. to 4 P. M.

The Board of Trustees of the Town of Jefferson meets at Jefferson Village on the first Saturday of each month. Plats may be left with S. M. Thorn, 45 Bryan Block.

The Trustees of the Town of Cicero meet at the Town Hall in Austin, at 8 A. M., on the 1st and 3d Monday and last Saturday of the month.

Secretaries of the different Boards will do us a favor if they will inform us of any changes that may from time to time be made in the meetings or regulations of their several Boards.

DIRECTORY.

Academy of Sciences—No. 263 Wabash Avenue. Meets second Tuesday of every month, at 7 30 P. M.

Historical Society—204 Michigan Avenue. Dr. Bryson, Librarian.

Civil Engineers' Club of the Northwest—Meets at the rooms of the Academy of Sciences, the first Wednesday of each month. F. S. Chesbrough, Pres. L. P. Morehouse, Secy.

Free Library—S. E. cor Wabash Avenue and Madison street. Open from 9 A. M. to 9 P. M.

Chicago Chapter of the American Institute of Architects—145 Clark st., Rooms 43 and 44. Meetings, first and third Thursday of each month. President, W. W. Boyington. Vice President, P. B. Wight. Secretary, C. C. Miller. Treasurer, Jas. K. Willett.

PROSPECTUS

Of the learned professions, the only one country unrepresented by a journal devoted exclusively to its interests, is that of the Civil Engineer and Surveyor.

In Law, Medicine and Theology, every school, every shade of sect and opinion has its exponent, which records its progress from year to year and carefully notes each new development. In Civil Engineering there is an American Eclectic Journal, and many Foreign Periodicals, but these are high in price, and addressed only to a few of the most advanced workers in the profession. To fill the vacancy now existing in the Engineering literature of the country, "The Engineer and Surveyor" is sent forth, and it will be the aim of the publisher to make it a Journal well worthy of the noble profession which it proposes to represent.

Some of the subjects to be considered will be:

Theoretical and Practical Surveying.
The United States Land System.
The Survey, and Sanitary Improvement of Towns, Cities and Villages.
The Survey and Construction of Roads, Railroads, and Canals, and the improvement of Lakes and Rivers.
Hydraulic and Mining Engineering.
The Reclamation, Drainage and Irrigation of land.
Mechanical Engineering.
Maps and Map Drawing.
Technical Education.

Besides this list, there will be given well digested reviews of the Real Estate, Iron and Coal trades; the reports of scientific societies, Supreme Court decisions in contested surveys; selections from scientific journals, American and Foreign, notices of the latest scientific publications, and such other matter as may be of interest to every surveyor, civil engineer, land owner, or general reader.

Arrangements are now being made to secure correspondents in every State in the Union and in Europe, and to obtain the most accurate and reliable descriptions of important Surveying and Engineering operations.

"The Engineer and Surveyor" invites the profession to use it as a medium of communication between themselves and the public, and hopes by such mutual intercourse to promote the welfare of themselves and contribute materially to the public weal.

We propose to publish during the year, several valuable maps and will endeavor to fully illustrate the most important articles.

"The Engineer and Surveyor" will be printed in octavo form on paper 24x36 inches, and will be issued monthly, at Two Dollars per annum, payable, in all cases, in advance.

GEO. H. FROST.
Proprietor.
187 Room 2

1874

The beginning of *Engineering News*—a monthly.

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center; this distance can be used with safety in the east,
on hard soil, but not in the west on our alluvial formations,
where ties are usually placed two feet apart.

Entered according to Act of Congress, in the Year 1874, by George H. Frost, in the Office of the Librarian of Congress, at Washington.

"ENGINEERING NEWS" STARTED AS A SURVEYOR'S PAPER IN APRIL, 1874

It was during the hard times of 1873, when the land boom at Chicago had burst and the surveying business was extremely dull, that Mr. Frost first conceived the idea of publishing a journal for civil engineers. Except for an amateur venture in the publication of a small real-estate journal a dozen years earlier, he had had no experience whatever in the publishing business; but he himself had many times felt the need of some journal that would give him information on the problems which he met in his daily work.

At that time the only American journals which dealt with civil engineering were the *Railroad Gazette,* which contained many articles of interest to civil engineers engaged in railway location and construction, and *Van Nostrand's Engineering Magazine.* The latter journal was made up of articles reprinted from other scientific and technical journals, principally foreign.

Of his plans for the new journal, Mr. Frost wrote in reminiscences prepared at the request of the editors over 20 years ago:

> I realized the need of a strictly professional civil-engineering journal, and for years I expected to see one started, but it did not come, and in the disheartening days of 1873 and 1874 I conceived the idea of publishing such a journal myself. It was a serious matter for me, as I did not have any loose cash within reach with which to launch my idea into material form. The idea of such a paper so fastened itself upon me, however, that I forgot all about my lack of funds and my ignorance of general civil-engineering practice and of the actual mechanical work of publication. Yet if somebody else had started any semblance of the publication I had in mind, up to the day my first copy went to the printer, I would have abandoned my project and become a warm supporter of the other scheme.

A Journal for Land Surveyors

As Mr. Frost's experience had been almost wholly in land surveying, it seemed natural to address his journal especially to land surveyors. For the first issue, which appeared on Apr. 13, 1874, under the title *Engineer and Surveyor,* Mr. Frost himself prepared the matter in the evening after his day's work as a surveyor was finished. He had, however, made the acquaintance of a young English civil and mining engineer, Charles J. Moore, and secured his aid in editing the second and succeeding issues of the journal until the end of the year. Mr. Moore changed the name to *The Engineer, Architect and Surveyor,* and introduced some matter of interest to civil engineers. In later years, Mr. Moore became one of the leading mining engineers of Colorado and accumulated a fortune.

The Engineer, Architect and Surveyor was a monthly journal of 16 pages, with a very small subscription list and no advertisements, and its publication was a heavy drain on the earnings of its owner.

At the beginning of 1875 the name was changed to *Engineering News,* and the subscription price was reduced to $1 per year. The second volume was a considerable im-

provement over the first, but the monthly deficits were larger.

Change from a Monthly to a Weekly

Notwithstanding these very discouraging results of the first two years, Mr. Frost determined at the beginning of 1876 to change the journal from a monthly to a weekly. The size of the page was increased to that which was thereafter followed for 35 years and the subscription price was raised to $2.12. Each number contained eight pages, and on the last two pages a few advertisements were interspersed with reading matter. Six months later the paper was increased to 12 pages, and the advertisements were restricted to the four outside pages and separately numbered to permit binding the matter without advertisements at the end of a volume.

The first paid contributor to *Engineering News* was the late Prof. Charles E. Greene, Professor of Civil Engineering at the University of Michigan. A series of papers on the graphical analysis of roof trusses, by Professor Greene, was published in 1875-76. Professor Greene also contributed other articles and editorials. Among other well-known engineers of that date who were contributors to the new journal were Prof. Charles A. Smith, of Washington University, St. Louis; Prof. Mansfield Merriman, then at Lehigh University, and W. Milnor Roberts, who was president of the American Society of Civil Engineers in 1879.

The First Salaried Editor

On July 1, 1876, *Engineering News* had for the first time a salaried editor, the late Lyman E. Cooley, of Chicago. Professor Cooley had recently graduated from Rensselaer and was then teaching at Northwestern University. Mr. Frost says of him in his reminiscences:

> Professor Cooley was an exceedingly aggressive factor in matters relating to the hydrographic condition of the continent, and his editorial contributions soon showed the bent of his mind. He was a strong partisan, and it was frequently a sore trial for him to have to eliminate politics from the journal, which of necessity had carefully to eschew political questions, especially as the political faiths of the proprietor and editor were diametrically opposed to each other; but Editor Cooley was a most industrious writer, and for a year was a valuable factor in the upbuilding of "Engineering News."

Mr. Cooley left at the end of a year to undertake work on the Glasgow bridge in Louisiana, which was then under construction under the late Gen. William Sooy Smith.

For the next two years, Mr. Frost appears to have done himself most of such editorial work as was done. He had, however, been made assignee of a bankrupt hardware concern and was obliged to spend most of the daylight hours there. From 5 p.m. till midnight, and an occasional hour in the morning and at noon, was all the time he could give to his journal; although most of his salary of $35 a week as assignee went to pay its deficits.

One stroke of enterprise, which did a great deal to keep the new journal from dying, was the republication of a British book on sewerage by Baldwin Latham, as weekly supplements to *Engineering News*. The book retailed at $15 and was in great demand among engineers, so the chance to obtain it free as part of the subscription to a $2 journal was generally seized upon.

One feature on which Mr. Frost lays great stress in his reminiscences is the personal and social development that he experienced in those years as a result of attending the

ENGINEERING NEWS

A WEEKLY JOURNAL OF ENGINEERING, MINING MANUFACTURES, AND GENERAL SCIENCE

Vol. III.—No. 1. CHICAGO, SATURDAY, JANUARY 1, 1876. Subscription $2.12 per year. Single copies, 4 cents.

GRAPHICAL ANALYSIS OF ROOF TRUSSES.

1876

The first appearance of *Engineering News* as a weekly

IN 1876 "ENGINEERING NEWS" FIRST APPEARED AS A WEEKLY

conventions of the national engineering societies. In 1878 he attended the convention of the American Institute of Mining Engineers at Chattanooga, and he writes of his experiences there:

> I met many prominent Eastern civil and mining engineers who already knew of "Engineering News." Decidedly the most notable man I met here for the first time was Alexander Lyman Holley, easily one of the most gifted of men, intellectually and socially, of his time.
>
> The meeting with these men had a most expanding influence on my mind, and my ambition was stimulated to make a paper worthy of their notice and patronage. The social life of Chicago was as yet crude as compared with that of the older East, and the easy, charming manners of the prominent men whom I met quickened my desire for further acquaintance.

A journey to Boston shortly afterward, to attend the American Society of Civil Engineers' convention, stimulated in Mr. Frost's mind the desire to remove to the East and publish his paper in New York instead of Chicago. On Dec. 1, 1878, this removal was carried into effect. He left Chicago, after paying his railway fare, with $35 in cash and with a wardrobe for which a good-sized valise was quite sufficient. Traveling by way of Canada, he borrowed $500 from his brothers and with this supply of funds landed in New York. Of this removal, Mr. Frost remarks:

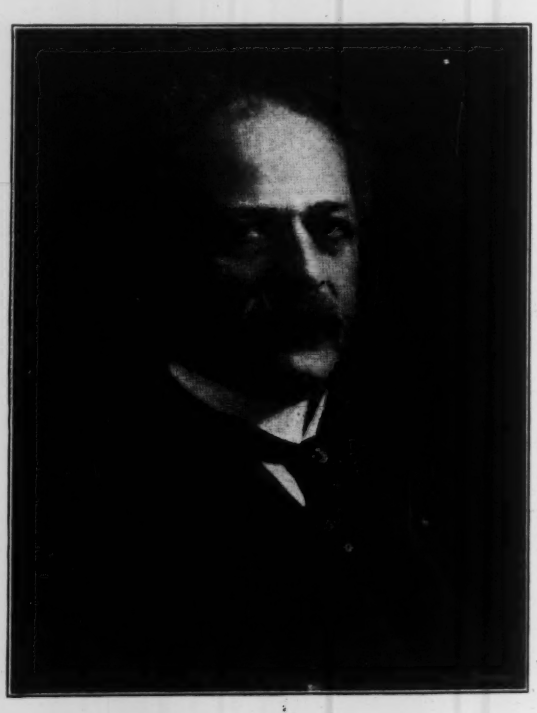
> I think no Southern slave ever worked much harder or more continuously than I had for many of those years spent in Chicago. If there is one event of my life which was not a mistake, it was this important, though blind, leap into the unknown which I made when I moved to New York.

Mr. Frost rented offices in the Tribune Building, and for 21 years the paper was issued and published from there. At the time of its removal to New York, *Engineering*

News had about 1200 paid subscribers. Small though this may seem, it must be remembered that the civil engineers of America were a small group in that day.

One of the most serious difficulties that confronted Mr. Frost was the securing of a proper editor for his journal. He clearly recognized the need of setting a higher standard in his journal than it had attained while he had attempted to act as both editor and publisher in the years in Chicago. Describing his experiences at this time he writes:

In 1883 the Editoral Management of "Engineering News" Passed Into the Hands of a Civil Engineer



D. McN. Stauffer

There were a number of professional hack writers then infesting the offices of class journals, and they had been mentioned to me by name. Strange to say, they did all apply at various intervals for the privilege of editing "Engineering News." Failing success, they sent in long contributions, which I rejected and heard nothing more from them.

In my perplexity concerning an editor, I write to a civil engineer in Michigan, whom I had never seen, but who had conducted a "Query Box" in "Engineering News," to leave his position as school teacher in Michigan and come to New York on a six months' engagement.

One day a long-bearded, stoop-shouldered, slow-moving man presented himself at the office and introduced himself as my new editor. My heart sank into my boots at the thought of having contracted to pay this man for six months. A moment's glance revealed his total unfitness for the place to which I had summoned him, and for New York life entirely, but I set him at work and for one month endured his presence. He was absolutely of no use whatever. He was worse; he was in the way of another man, while I was too impecunious to pay him six months' salary and send him away.

Finally, I informed him that we had both made a mistake and he had better return to Michigan and send contributions from there. He went, but brought suit for the full salary, and I asked my lawyer to delay the case until my finances were in a more prosperous condition. Two years later I settled the claim.

Another editorial writer in those early days was an Irishman by the name of Derrick, an educated man and a genius in his way, especially in languages. Besides translating technical articles, Mr. Derrick compiled a "foreign letter" from various sources and languages, which was properly dated and published.

Mr. Derrick had a special weakness for the flowing bowl, so that he could not always be depended upon; and occasionally he wrote between drinks, and so got his copy badly tangled. Our readers thus lost much very entertaining matter from this versatile translator's pen. He was so aware of his own weakness that he would not draw more than $2 at a time until forced by actual necessity to ask for money. If by chance he got $5 in his pocket, he became invisible and incapable until it was spent.

Another experiment in the editorial line, of a very different order, is thus described by Mr. Frost:

In 1881 I was feeling the need of an editor having a broad engineering experience and able to tell my subscribers what was most interesting in engineering circles. Somebody suggested Col. Julius W. Adams, a distinguished engineer and public-works official of many years' experience in Brooklyn and New York and a past president of the American Society of Civil Engineers.

I wrote Colonel Adams offering him $50 per week for his services as editor. Colonel Adams called at once and expressed his high appreciation of the proposed honor, but said in the most deprecating way that he couldn't earn the proposed salary, that he was well on in years and inclined to be leisurely in his habits, and would take only $25 per week.

On these terms the colonel started in, with his name at the top of the column as responsible editor. He was not engaged in other work at the time and thoroughly enjoyed his new duties, but he was a politician and a born fighter, and never could forget old feuds, and it wasn't long before he began to "put the types" on some of his ancient enemies or political opponents. He soon sent in such inflammatory copy that it had to be suppressed by me, and in a few months he decided that editing a neutral journal was not his forte, and therefore resigned.

Finding an Editor and Partner

During the vicissitudes of these first four years in New York, the paper had a modest growth, notwithstanding its eccentricities in editorial conduct.

At the beginning of 1883, Mr. Frost solved the long-perplexing problem of editorial management by selling one-third interest in his journal to D. McN. Stauffer. Mr. Stauffer had had nearly 20 years' active experience in civil-engineering work, chiefly in Philadelphia, and was a man of most attractive personality with a wide circle of friends. Besides his abilities as an engineer, Mr. Stauffer had much talent as an amateur artist. He had already contributed sketches to *Engineering News,* and the work of his skillful pencil as well as his pen was at once noticeable in the pages of the journal.

For the first time in the history of *Engineering News,* its editorial conduct was in the hands of a man thoroughly experienced in the various branches of civil engineering and competent not only to prepare articles representing the results of that experience, but to pass critical judgment on the work of contributors. Mr. Stauffer had had, however, no experience whatever in journalism; and while an immediate improvement was noticeable in the technical articles in the paper, much of the matter was presented in very crude form.

Those were the days of small things in technical journalism. As late as the end of 1886 the entire office force consisted of Mr. Stauffer as editor, assisted by Mr. E. E. R. Tratman, a young engineer from the Long Island R.R., who had begun work for the paper a few months earlier, principally to take charge of the then embryo Construc-

tion News Department; Mr. Frost as general-utility man; and a clerk to carry on the very primitive bookkeeping and keep the subscription list. This latter was not so large, by the way, but the clerk was able to memorize every name on the list, and could tell offhand whether a man was a subscriber or not. The office did not even boast a typewriter.

The Coming of Wellington

It was into this primitive and amateur publishing organization that there burst in January, 1887, a whirlwind of energy in the person of Arthur Mellen Wellington. He had made a high reputation by his treatise on the "Economic Location of Railways" and had had two years' experience as an associate editor on the *Railroad Gazette*, which was at that time a prosperous and long-established journal catering to the needs of civil engineers engaged in railway construction and maintenance, as well as to other railway officers. A change in organization of the *Railroad Gazette* staff resulted in Mr. Wellington's resignation; he immediately came to *Engineering News*, purchased a one-third interest in the paper and was installed in editorial charge.

The rapid growth of *Engineering News* dates from that time. Mr. Wellington was a man of great originality and initiative, an indefatigable worker and with sufficient previous experience in technical journalism to have ideas as to the methods by which a strong engineering journal might be developed. While the names of both Mr. Stauffer and Mr. Wellington appeared as editors of the journal, from that time on Mr. Wellington contributed the driving force and carried the chief responsibility. He threw himself heart and soul into the new enterprise. Mr. Stauffer, whose tastes were artistic and literary, was entirely content to yield the main responsibility, although many times his conservative judgment was a valuable check upon the impetuosity and occasional partisan attitude of his associate.

The various schemes that Mr. Wellington's fertile brain evolved for the development of the journal made necessary almost at once an expansion of the staff. The first accession, early in 1887, was Charles Whiting Baker. At the same time, F. P. Burt, a young Canadian engineer with a special artistic talent, was brought to establish the nucleus of an illustration department. Later in the year, M. N. Baker joined the staff and began work in the field of water-works and municipal engineering.

Investigating Engineering Accidents

Immediately upon Mr. Wellington's accession, he established the policy of investigating accidents to important engineering structures, for the purpose of obtaining lessons of practical interest to engineers. Almost the first notable achievement of this sort was in connection with the Bussey bridge disaster on the Boston & Providence R.R. in the suburbs of Boston, which occurred on Mar. 14, 1887, and caused the death of over 30 people.

Just after news of the accident reached New York, Mr. Wellington happened to meet a bridge-engineer acquaintance on the street, Henry S. Pritchard, and asked him to take the first train to Boston and find the cause of failure of the bridge. Mr. Pritchard arrived at the scene of the disaster 27 hours after the accident. Upon inspection of the wreckage he found almost at once the pair of broken floor-beam hangers whose failure had caused the disaster. Nobody apparently had paid any attention to them or realized their importance in a technical investigation of the causes of the wreck. An obliging workman knocked the hangers free from overlying wreckage, and Mr. Pritchard joined the procession of relic hunters who were carrying off souvenirs.

Great was the amazement of the railway officers and the authorities of the Commonwealth of Massachusetts when the next issue of *Engineering News* appeared two days later with a complete analysis of the accident and its causes, large-scale sketches of the hangers and the announcement that the very parts whose failure had caused the disaster were in the possession of *Engineering News*.

There was much talk in the Boston papers about criminal prosecutions for removing evidence and requisitions on the governor of New York, somewhat disquieting to the energetic engineer who had secured this valuable bit of scrap iron; but when the hangers were returned in due time to the custody of the State Railroad Commission, the excitement subsided.

The Rapid Growth of "Engineering News" Dates from His Purchase of a Third Interest in the Paper in 1887

A. M. Wellington

This incident was merely typical of the energy, originality and vigor that Mr. Wellington brought to the journal. Under his leadership the subscription list was doubled within two years, and advertising patronage increased in proportion. The growth of the paper thence-

forth was coincident with the rapid expansion in the field of engineering and in construction work of all sorts, which marked the period from 1887 to 1893.

MR. BAKER SUCCEEDS MR. WELLINGTON

Mr. Wellington had overtaxed himself in the preparation of his monumental treatise on railway location, which was published about the time he came to *Engineering News*. In the early '90's, Mr. Wellington's health failed. He had been a prodigious worker, carrying on an extensive consulting practice in addition to his editorial work, and in 1895 his death occurred. In the years previous, during Mr. Wellington's long absences and extended illness, Charles Whiting Baker had been in charge of the paper, and at Mr. Wellington's death succeeded him as editor.

The years of business depression from 1893 until near the close of the century, while they checked the growth of the journal, never placed it on the downgrade. With the resumption of business activity and prosperity for engineers, the expansion of the journal began anew.

It is of interest to note that a considerable number of men who gained their early experience on the editorial or business staff of *Engineering News*, have in later years become prominent in connection with other journals. Among these are the late Myron C. Clark, founder of the Myron C. Clark Publishing Co., Halbert P. Gillette, Editor of *Engineering and Contracting*, Merton C. Robbins, Manager of *The Iron Age*, John M. Goodell, for many years Editor of *Engineering Record*, and Charles S. Hill, Editor of *The Contractor*.

It has been mentioned above that the founder of the journal, Mr. Frost, at one time parted with two-thirds of his interest in it to his associates. In later years he repurchased these interests. That of Mr. Stauffer was acquired in 1908, at which time Mr. Stauffer retired.

In August, 1911, realizing his advancing years, Mr. Frost sold the journal to the Hill Publishing Co. At the beginning of the following volume, the size of the paper was changed to conform to the standard now adopted by most American technical journals. The remaining history of the paper is too recent to require chronicling here.

Higher Maintenance Costs Follow Railway Electrification

THE presence of the third rail or the overhead conductor on electrically operated sections of steam railways has a tendency to increase the cost of maintenance-of-way and structures, according to the report of a committee of the American Railway Engineering Association. This conclusion is based upon information from lines operating 1803 miles of main and sidetrack by the overhead system and 707 miles by the third-rail system.

The maintenance of working conductors, positive and negative cables, track bonding, etc., is under the maintenance-of-way department. The work is performed as far as possible by the existing organization, with such additions as may be necessary on each line. No material changes have been required in length of track sections or in force employed. Special rules and instructions are issued in most cases. There is some reduction in efficiency of the men, and consequent increase in cost of work, on third-rail lines, due partly to fear of injury and partly to the physical obstruction in walking and working on the track. With the overhead system there is a similar effect in the reduction of efficiency or increase of cost where the work of repairing stations and bridges is in proximity to high-voltage wires.

As to the track itself, the longer ties required to carry the third rail tend to load the ballast unequally; and unless care is taken to tamp the long ties for their full length, the track is apt to get out of cross-level irregularly and objectionably. The presence of the third rail increases the cost of renewing ties and rails (about 15% each) and distributing ballast (10%). It also increases the difficulty of lining and surfacing track. It restricts the use of hand-cars and motor section-cars, and on multiple-track lines makes it difficult, if not impossible, to carry such cars from one track to another. Special care is required in handling rails, ties, switches, etc., but the increase in cost is partly offset by the general use of machinery for such work. For cattle guards, the use of metal should be avoided.

With the overhead system it is practically impossible to afford at all points sufficient clearance for employees standing on top of the highest cars. Signs or warning guards are required at low points, but the latter are liable to damage by the pantographs on the engines. In the attachment of the wires to existing bridges and other structures it is necessary to afford ample insulation between them and to provide against contact between the structure and the trolley or pantograph. The overhead conductor also has an effect upon the design and location of signals.

With either the third rail or the overhead conductor a drawbridge presents a special problem to provide propulsion current without long gaps. A submarine cable can be carried to the pier to supply current to the conductor on the bridge, with a very small gap at the ends of the structure. Steel structures (bridges or buildings) in close proximity to the third rail or the overhead wire should be protected by a device to open the circuit-breakers in case of a short-circuit to the structure. Snow and sleet may cause trouble with either system and necessitate the use of calcium chloride and scrapers to clear the rail or wire, while at terminals live steam may be used to clear ice from the pantographs.

As to the effect upon the rails, the flange wear on curves is believed to be greater with multiple-unit equipment than with steam equipment. In one case this is estimated at 25%. The damage to the wheels is less than with steam operation. The corrugation of the rail head is a noticeable detail where multiple-unit equipment is used, and is attributed to the fact that the trucks are heavier than those adopted with steam equipment. With electric locomotives the rail wear is believed to be no greater than with steam locomotives of equal weight and wheelbase. In some designs of electric locomotives the proportion of the total weight that is below the springs requires the maintenance of track in better line and surface than with steam equipment and necessitates designing the locomotive so as to restrict lateral movements that otherwise might become of such magnitude as to injure or displace the track.

These features of electric equipment have also brought about the strengthening of spikes and tie-plates, thus adding to the cost of track construction, but tending to reduce the cost of track maintenance.

Relations Between Sewage Disposal and Water Supply Are Changing

An Appraisal of Progress Is Made, Viewed in the Light of Recent Developments in the Field of Sanitary Engineering

By GEORGE W. FULLER
Consulting Engineer, New York City

ABOUT 30 years ago came the beginning of municipal sewage disposal for American cities. That was the period when the germ theory of disease was coming into general recognition and the Massachusetts State Board of Health was reorganized, with its experiment station at Lawrence to coördinate the engineering, chemical and biological aspects of the purification of water and sewage along modern lines.

During the past 25 years the successful achievements in the field of water purification constitute one of the brightest pages in the field of Sanitary Engineering in America. It is true that there is much work still to be done in the field of water purification, both as regards its general adoption and its application at certain places where local conditions call for special treatment. Apparently progress in water filtration has been somewhat retarded through efforts to make chlorination serve as a substitute for it under conditions where it is not entirely adequate. Chlorination has done a great deal of good in the improvement of public water supplies. But it is not a cure-all, and its limitations are far more clearly appreciated with the practical proofs now existing than when academically recited six or eight years ago.

The Status of Chlorination

In order to effect an adequate removal of objectionable bacteria it is necessary to apply chlorine in quantities sufficient to combine with the dissolved and suspended organic matters before the chemical will act upon the living organisms. The temperature of the water and period of reaction are likewise important. The great difficulty, however, lies in the inability to measure the amount of chlorine which the soluble and suspended (dead) organic matters use up before the chlorine becomes available for destroying the living organisms. Hence for many water supplies, subject to chlorination without filtration, real difficulties are encountered in adjusting the dose of chlorine so as to guard against objectionable taste and odors, on the one hand, and inadequate destruction of objectionable bacteria on the other.

Undoubtedly chlorination allows public water supplies of good quality to be furnished without filtration under some special conditions. Newark, N. J., for example, has spent in the vicinity of $1,300,000 for the acquisition of properties upon its watershed for the purpose of preventing pollution, and it is understood that the city now owns about 65% of the watershed. The population has been reduced from between 35 and 40 per square mile in 1900 to a present population of about 16 per square mile for permanent residents and 5 per square mile for summer boarders. Chlorination is resorted to only after heavy rains, and yet the typhoid fever death rate is among the lowest of the large cities of the world. This is a highly commendable result, regardless of any financial comparisons which might be made of the cost of filtration as contrasted with watershed protection.

Present-day consideration of sewage disposal as related to water supplies involves the assumption that a first-class water supply from surface sources shall be subjected to efficient filtration, preferably aided by chlorination. There may be exceptions to this rule in instances where long periods of sedimentation are provided for water taken from sparsely inhabited watersheds. Where water filtration is not installed it is interesting to note, in passing, the efforts made by various communities to avoid the effects of sewage pollution.

Chances of Pollution on Watersheds

The custom established at Boston was later followed by New York City. The latter city spent several million dollars 20 years or so ago to eliminate pollution upon the Croton watershed and at its own expense installed and operates sewage purification works in several villages as, for example, Mount Kisco. Yet the City of New York is properly objecting to the establishment of an insane asylum and a training school on its watershed. It is also noteworthy that there is before the Legislature at Albany a bill which provides for a trunk sewer in the Sawmill River valley, through which it has been suggested that the triple-filtered and chlorinated sewage of Mount Kisco shall be delivered to the Hudson River.

Jersey City, some 20 years ago, contracted for an impounded water supply of pure and wholesome quality, to be obtained without filtration from the Rockaway River with an impounding reservoir at Boonton where the water chlorination process was first tried in an exhaustive manner. Increasing population in the towns and villages on the Rockaway watershed has recently emphasized the continued desires of Jersey City to have no purified sewage enter its impounding reservoir, even if it means a relatively large expense for an intercepting sewer discharging the liquid wastes below the Boonton dam.

The towns along the north shore of Lake Michigan adjacent to Chicago are in some instances supplied with indifferently chlorinated and indifferently filtered public water supplies from Lake Michigan, but they have recently considered the enormous expense incident to the removal of all sewage of the recently created North Shore Sanitary District from the lake waters. Likewise, Milwaukee, with a program for a city water supply which does not include filtration, and which is also handicapped by objectionable results from chlorination, either as to bacteria or tastes, or both, is planning large expenditures on sewage disposal to secure a degree of purification sufficient at all times to guard against the pollution of its water supply.

Almost everyone naturally has sympathy with communities which endeavor to preclude sewage pollution from their water supplies. Sanitary engineering in

America, however, has been developing a general program of favoring sewage disposal in relation to water supply along those lines which will give the greatest total benefit for a given expenditure of money. Unquestionably sentimental developments bring many problems, at least on paper, outside of the scope of that relationship. And where the citizens can afford it they will no doubt proceed with that which they desire. Under such circumstances no one should object.

Inefficient Sewage Works Operation

Unfortunately in the past, sewage disposal in treatment works of artificial construction has too often, although needlessly, failed to accomplish that which was expected of it. No matter how adequately sewage works may be designed and built, it is necessary to operate them properly. Inadequate attention to operation is a great weakness in the sewage disposal record of American towns and cities. Statistics compiled by a Committee of the American Public Health Association last year showed that of 1294 American sewage disposal plants, only about 60 were provided with laboratory facilities and presumably with a proper operating staff. However, this record is not as bad as might appear at first glance, as only 93 of the plants serve communities of over 10,000 people.

Perhaps the most striking change in the viewpoint of engineers as to the relation between sewage disposal and water supply is the need of looking at these problems objectively and not subjectively; that is, not in the light of what they might accomplish, but of the work which they really do. In many sections of the country it is unquestionably true that waterways must carry a greater or less portion of the sewage wastes. Prof. Earle B. Phelps has recently stated in the U. S. Public Health Reports a general principle for coördinating conflicting viewpoints, as follows:

"Conservation of natural resources demands that the greatest possible advantageous utilization be made of the various properties of a stream. This may include such uses as navigation, drainage and irrigation, power development, domestic water supply, fishing as an industry, pleasurable and health-giving enjoyment by the people in such forms as boating, bathing and fishing, the disposal of sewage and waste, the enjoyment of scenic beauty, and various minor uses. These may all be indulged without further restriction than that the less important shall not interfere with or curtail the more important, the importance of any usage being measured in broad economic terms of public welfare."

It is no longer prudent to say offhand that an Imhoff tank, a fine screen, a trickling filter, or chlorination, is just what is needed for any particular local problem of sewage disposal. To a degree far greater than is generally or clearly realized, it is necessary to recognize that local problems of sewage disposal must be solved, if solved wisely, by adjustment to a wide range of local factors and conditions. The problems differ so widely that the idea of a general solution applicable to a great many problems is no longer satisfactory.

Both Water and Sewage Treatment for Cleveland

Cleveland, after wisely deciding to adopt water filtration, is now developing sewage treatment works to make the lake shore clean and the shore waters thoroughly safe for bathing during the warm season of the year. Surely this program of giving the citizens satisfactory conditions during the summer, although for a time it may mean that slightly treated sewage will be dispersed through multiple outlets in deep water far from shore during the winter, is wiser than to attempt to give the people less than they want in summer and more than they need in winter.

The 1909 Treaty between Great Britain and the United States with respect to controlling the pollution of boundary waters so that life and property on one side shall not injure health or property on the other has done much toward crystallizing the viewpoint herein discussed. Essentially work on boundary waters has been directed toward a coördination between natural conditions and agencies and needed works of artificial construction, all with a view of bringing about a combined effect intended to give proper hygienic results with due regard to the financial aspects of the case.

International Commission's Allowable Pollution

In 1914 the International Joint Commission, on the basis of expert testimony, endeavored to establish a limit in the pollution of boundary waters, the intention being to designate a proper load for water filters beyond which limit pollution should not be allowed to go. This testimony indicated an allowable degree of pollution corresponding upon an average to that found in the Thames River at Hampton, England, or to the condition of the Merrimac River water at Lawrence after the latter had been freed of about 90% of its pollution. An effort was made to study this question bacteriologically in terms of determinative B. coli, but the available presumptive B. coli data in this country are so intimately associated with uncertain methods of analysis indicating the presence jointly of fecal and non-fecal members of this group, that this phase of the subject is now much muddled and it will be necessary to get further data on a more reliable basis.

Professor Phelps has endeavored to express the bacteriological limits in the pollution of water which may be safely applied to water filters in terms of stream flow per capita, with due account given to "self-purification." This is, of course, desirable, but it in turn will have to be adjusted to sound data as to fecal pollution to be obtained with improved methods of bacteriological analysis.

Treasury Department Standard

The so-called Treasury Department Standard of waters used by interstate carriers, that is, with a maximum limit of 2 B. coli per 100 c.c., has a direct bearing also upon this question, as inevitably a safe loading upon water filters will also be limited by taking a certain assumed quality of output and then working backward from that result. Here, too, the reliability of methods of analysis past, present and prospective, comes clearly to the front.

Enough has been said to show that the art of sewage disposal is undergoing a change in its relation to water supply along what is believed to be sound and rational lines. Unfortunately the yardsticks for measuring the results are unquestionably crude and subject to material improvement, to say nothing of the exceptions which may be exploited, to a normal relationship of sewage disposal and water supply. As a general proposition, however, the idea of predicating the solution of these municipal problems on the results which ought to be actually accomplished under various local conditions cannot be controverted.

Civilian Engineers Instruct "Rookies" at Citizens' Training Camp

Technically Trained Men Acquire a Working Knowledge and a Fair Proficiency in the Methods of Warfare —Profit by Lesson of European Conflict

By J. W. SWAREN
Hayward, Calif.

ALTHOUGH the citizens' training camp at Monterey, Calif., was essentially an infantry camp, a training in the fundamentals of military map-making, bridging and field fortification was given. As only one engineer officer and a detachment of 14 engineer troops from Company F, Second Regiment, United States Engineers, were assigned to the Monterey camp, civilian engineers who cared for extra training in these branches were utilized as instructors. Preliminary instruction was given these men after the regular infantry work of the day was completed. Afterward, selected men were excused from the greater portion of the strictly infantry work for five days. This arrangement permitted the execution of a greater variety of work and a more personal degree of instruction to the non-technical students than would have been attained otherwise. With an average strength only slightly under 1200 men, the value of this arrangement was high. Since no military map of the maneuver area was available, a control map was the first work assigned to the engineer student corps. A section of the Monterey United States Geological Survey sheet was enlarged and the military features added by service methods, the area being divided into suitable sectors and a party assigned to each. The entire area was mapped in a single day; during the night a draftsman in the engineer detachment closed and traced the field maps, and issue of finished maps was made to all company officers the morning following. The men employed on this reconnoissance were afterward utilized as instructors in the principles of road sketching. This work consisted of a lecture on the use of the service instruments, followed by a short road traverse.

HEAVY LAND MINES AID DEFENSIVE WORKS

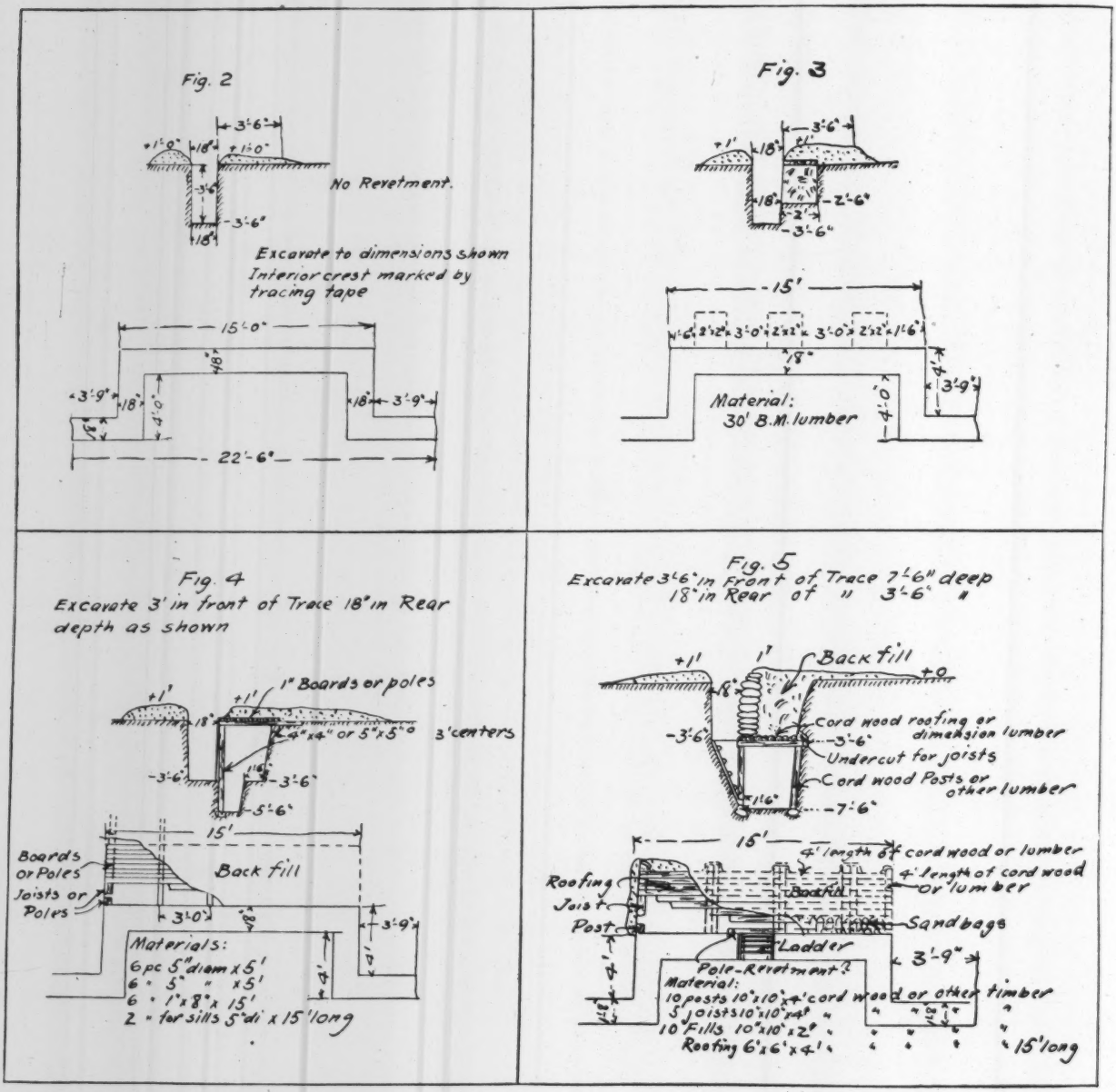
Spar and ponton bridging methods were shown. Two evening periods were spent in teaching the engineers the specified knots and lashings and bent framing. On the third day the entire training regiment was marched to a selected canyon in the Presidio grounds and undertook the building of a double-lock spar bridge. The engineer "rookies" were detailed to the clearing of the site, framing of bents and distance frame, and erection. The regiment, less the engineers, was assigned to the task of felling trees, trimming timbers and transporting these to assigned yards. A standard 45-ft. double-lock span was erected, and then demolished by explosives.

Ponton Bridge Built in 27 Minutes

Ponton instruction was given with the light equipage with the Rees type of portal trestle. One evening was spent in teaching the mechanism of the trestle and ponton assembly. This was followed by six drills, laying a six-pier (trestle, four pontons and one crib) bridge across a neighboring lagoon. Next, there was an exhibition drill, 36 men participating, the entire bridge, 108 ft. long, being laid in 27 min. Then came the demolition by explosives of one bay. The bridge was afterward dismantled, 7 min. being consumed in removing all chess and balk, while in 13 min. the pontons and trestle were dismantled and stowed in proper order on shore. While far from a record, it is a good indication of the possibilities of engineer training. Previous to this experience most of the participants had been imbued with the idea that military engineering was essentially makeshift, accuracy being of little importance. It was found, however, that the trestle must be lined with great accuracy and erected with a precision that seemed impossible of attainment with such apparently crude equipment, or the offshore terminal would not land where desired. However, after the maul and stake squad had laid and relaid the ramp mudsill a few times, the idea was caught, and thereafter the work proceeded without the difficulties which were encountered in the early days of training.

Chief Interest in Field Fortification

Chief interest, however, centered on the works in field fortification. With the exception of the mine sap, these were laid out on the basis of complete shelter for one company reinforced by a machine-gun platoon. The site selected for this work was a long narrow clearing in the



QUICKLY PREPARED BLUEPRINTS IN HANDS OF ENGINEERS GUIDED WORK OF SPECIALLY DETAILED SQUADS

chaparral that covered a large portion of the maneuver area. Though there were several cross-gullies, the maximum difference of elevation was not over 6 feet.

Trench Construction Problems

Special instruction covering location of trench trace, delaying works and shelter was given to the engineer corps. Each engineer was assigned a definite task, and issued blueprints covering it. The actual work was done by details from the regiment and was spread out over three days. As each detail worked but a short time on a task, moving on to the next, every man had an opportunity to study each provision of the entire works.

The soil was an old compacted beach sand, standing well for several days without shoring or revetment, but caving badly after considerable exposure. It was fortunate that not more than half a dozen cave-ins requiring even temporary support occurred, as available revetment material was scarce, the manzanita chaparral being entirely unsuited for making gabions. It is frequently said that one of the chief points of difference between civil and military engineering, is that cost in the latter is of little consideration. These conditions indicated pointedly that economy of material is a prime consideration in all military work. This becomes doubly true in a devastated theater of operation. Also, it brought out that the military map should carefully show every timber structure, even the humble board fence having other uses than merely as a supply of fuel, while a flume might be a veritable gift of heaven if it paralleled a line of fire trenches.

A single line of fire trenches consisting of 10 traversed squad trenches was located just below the skyline of a low knoll, the highest part of the area. Several trees that

SANDY SOIL MADE EASY WORK OF TRENCH DIGGING AND STOOD FOR SEVERAL DAYS WITHOUT SHORING

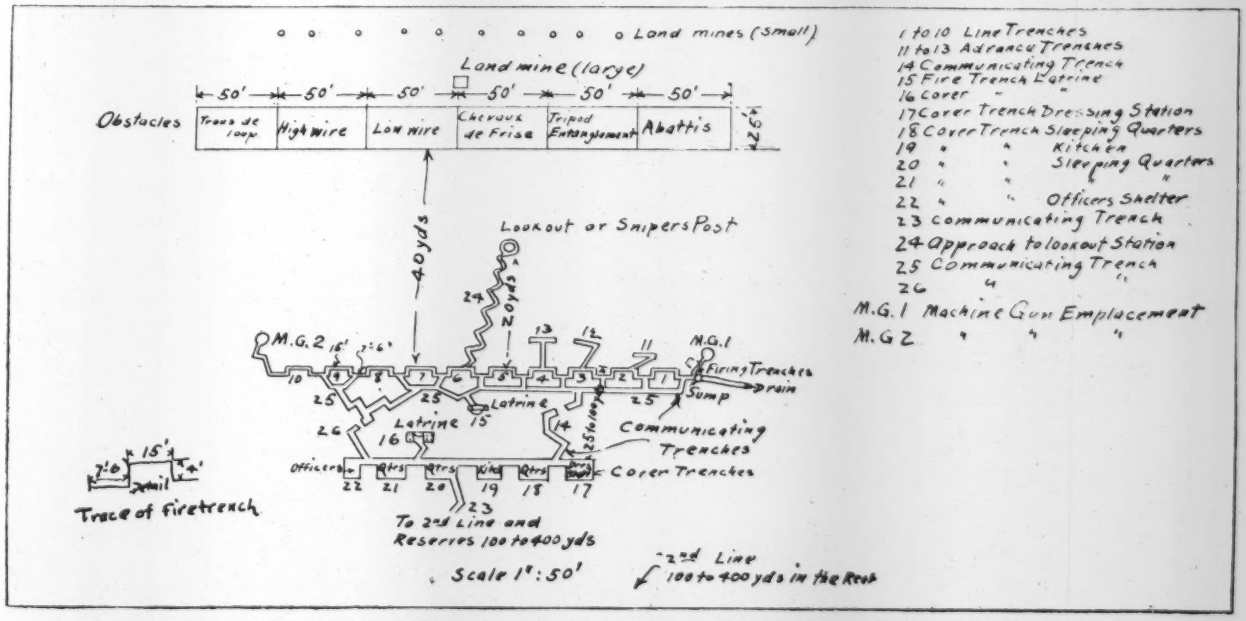
might serve as excellent aiming points were scattered over the area, and precautions to avoid these were taken. Machine-gun emplacements were located at each flank, with the embrasures permitting a grazing fire and covering the obstacles in front by crossfire. Sandbag revetments were used, and a 5-ft. 6-in. trench, with bullet-proof parapet and parados, connected these emplacements with the nearest squad trench.

The squad trenches were all of the narrow type, developed under the stress of the accurate artillery fire experienced in the present European War. Communication was provided by a labyrinth immediately in the rear. All traverses between the fire and communicating trenches were sufficiently thick to resist field-artillery fire, but the traverses between squad trenches were designed against rifle fire only. Each squad trench was designed to illustrate a different tactical principle.

Elbow rests were not provided in any instance, as it has been found that the men prefer to cut their own and, while pressing close to the front wall, are better protected from shrapnel or high-angle fire. The trench illustrated above is the type that ordinarily would be constructed when two or three hours are available before the advance of the enemy will probably make contact. The group of trenches, in the picture at the right, shows how a simple standing trench may be gradually strengthened to the strongest type of fieldwork.

Loopholes Constructed by Different Methods

Another series was intended to illustrate the use of revetments and loopholes. Its profile was 4 ft. wide at the top, excavated to elevation 3 ft. 6 in., where a firing step 1 ft. 6 in. wide was left on the front wall and the excavation continued to elevation 5. Brush and pole revetment supported the walls and floored the trench and firing-step treads. When the parapet had been raised 6 in., logs 8 in. in diameter were laid to form loopholes when covered by a roof of poles. The smaller diameter was laid inward, making the throat approximately 8 x 8 in.; the mouth was flared 18 in. wide, the increased diameter of

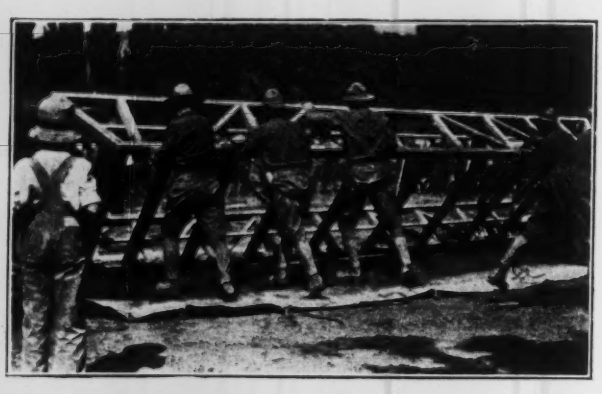


FIELD WORKS BUILT FROM HASTY SKETCHES AFFORDED SHELTER FOR ONE COMPANY AND A MACHINE-GUN PLATOON

the log bringing the height to approximately 10 in. Earth was piled on the roof until the parapet command was somewhat more than 2 ft. 6 in., the parados being brought to a similar height.

Another trench had exactly the same profile, but the loopholes were formed by open-ended plank boxes 8 x 8 in. at the throat, 3 ft. 6 in. long and 12 x 12 in. at the mouth. Still another was designed to illustrate the use of gabions and fascines; but as noted above, these could not be made, and sandbags were substituted. This trench was covered by wire netting carried on crossed stakes, designed for protection against hand grenades.

Each squad trench was connected to its neighbor on either side by an 18-in. communicating trench running around a traverse 3 ft. 9 in. thick and 4 ft. long. At each traverse a trench led back to a communication trench running the whole length of the position. These trenches were excavated to elevation 5 ft. 6 in., with 1-ft. parapets on each side. Being only 18 in. wide at the tread, good cover against rifle and shrapnel fire was provided. Drainage for the entire fire-trench system was provided by a



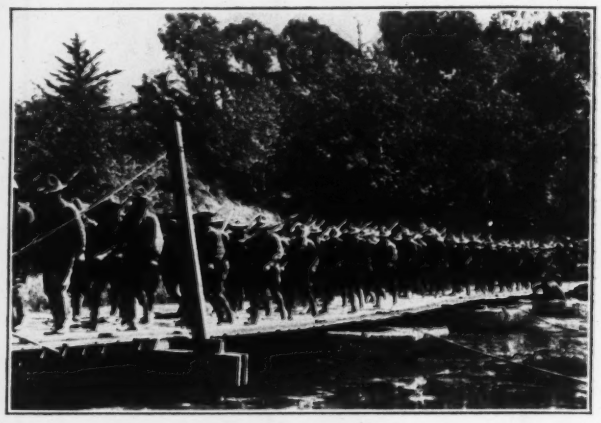
TEAM WORK THE FIRST REQUISITE

sump and drain on the right flank. As groundwater was not reached, this proved to be an unnecessary precaution, but served to draw attention to this feature of field fortification.

Communication Ways Must Be Defiladed

Two covered passageways, leading back to the cover trenches, were excavated to elevation 6 ft. 6 in. and roofed with planking carrying an earth cover 2 ft. deep. The one on the right flank was a single passageway 18 in. at the tread and was zigzagged with increasing angle to the perpendicular as the fire trenches were approached, illustrating the proper method of defilading. The one on the left flank was a double way, 36 in. at the tread, and maintained the same angle of zigzag, illustrating how the tangents become more and more enfiladed as the fire trenches are approached.

CHESS AND BALK ARE EASILY HANDLED



ACROSS A BRIDGE BUILT IN 27 MINUTES

An interesting feature of trench location was developed in the cover trenches. For most effective manning of the squad trenches, these should be not farther than 100 yd. in the rear; to minimize fire effect, not nearer than 25 yd. Placing the fire trenches under the skyline made it necessary either to expose the cover trenches to excessive fire or to place them at a distance so great that effective manning of the fire trenches was hampered. A compromise was effected by deflecting the line of cover trenches slightly and deepening the cover of the more exposed.

Six cover trenches, each 12 x 12 ft. and excavated to elevation 7 ft. 6 in., were built. Plank roofs supported by old railway ties for stanchions carried the earth cover, which was 6 ft. minimum. All were connected by communication trenches, and each had a ventilating opening at the rear. One was arranged as a dressing station, three as quarters for men, one for kitchen and one officers' quarters.

Delaying Works Constructed

Obstacles and delaying works were constructed over a zone 25 ft. wide, 40 yd. in front of the fire trenches. These were divided into six sections, each illustrating a definite type. Heavy land mines, light land mines and fougasses were laid in front of the obstacles; and in the tactical maneuver conducted to show the proper use of the works, a considerable diversion was caused by exploding these. But little instruction was given in mining and running saps, a single gallery being run about 25 ft. by the sheeting method; but due to lack of time, no attempt was made to build a grand gallery, drive listening galleries or sink shafts.

All the work described was executed under the direction of the engineer officer attached to the camp, Capt. Richard Park, Corps of Engineers, U.S.A., who permitted the use of the photographs and drawings herewith. It was due to his untiring labors that every attendant at the camp was enabled to get a comprehensive understanding of the elements of field engineering.

Concrete Structures Wrecked by Intense Heat at Cereal-Plant Fire Causing $2,000,000 Damage

Quaker Oats Co. Loses Nine Buildings of Various Types Covering Ground Area of 4 Acres; Temperature Estimated Above 2200° F.

FIRE of almost blast-furnace intensity started Dec. 11, 1916, by an explosion in the drying building and fed by stored supplies of highly inflammable cereals, destroyed in 12 hours practically the entire plant of the Quaker Oats Co., at Peterboro, Ont., consisting of nine buildings of different types, covering a ground area of 4 acres and representing a loss of $2,000,000. Twenty-six people were killed. Among the badly damaged structures was a large six-story reinforced-concrete warehouse of the flat-slab type, which, according to the evidence, had been subjected to temperatures higher than 2200° F. No type of structure, it is held, could have stood up under such intense heat of such long duration.

After the fire, W. W. Pearse, City Architect and Superintendent of Buildings of Toronto, Ont., delegated T. P. Mylrea, Engineer in Charge of Tests, to make a thorough investigation of the fire, particularly in regard to its effect upon the reinforced-concrete structures. From Mr. Mylrea's excellent report and from other facts brought out in the investigation by the Canadian Fire Underwriters' Association the accompanying description of the fire and its effect on the structures has been prepared.

The general layout of the Quaker Oats plant, which was devoted to the manufacture and storage of cereals, is given in Fig. 1. The buildings and their type were as follows:

Boiler house—Two-story brick; 50 x 92 ft. Drying building—Eight-story brick; concrete on steel floors, with wood roof; 53 x 92 ft. Mill—Eight-story brick; semi-mill floors and roof; 83 x 132 ft. Warehouse No. 1 and Office Building—Four-story brick; semi-mill floors and roof; 83 x 130 ft. and adjoining four-story brick; semi-mill floors and roof; 104 x 83 ft. All the preceding buildings were in one group and communicated through openings, mainly protected.

Cleaning mill—Six-story brick; semi-mill floors and roof; 44 x 59 ft.; 40 ft. west of drying building; communicated with latter through concrete tunnel in basement and metal bridge passage on top story, with firedoors. Elevator—Joined cleaning mill on north; ten-story frame metal-slab crib construction. Reinforced-concrete grain elevator with reinforced-concrete circular tanks —20 ft. north of elevator and communicated with it through concrete tunnel in the basement; steel passage

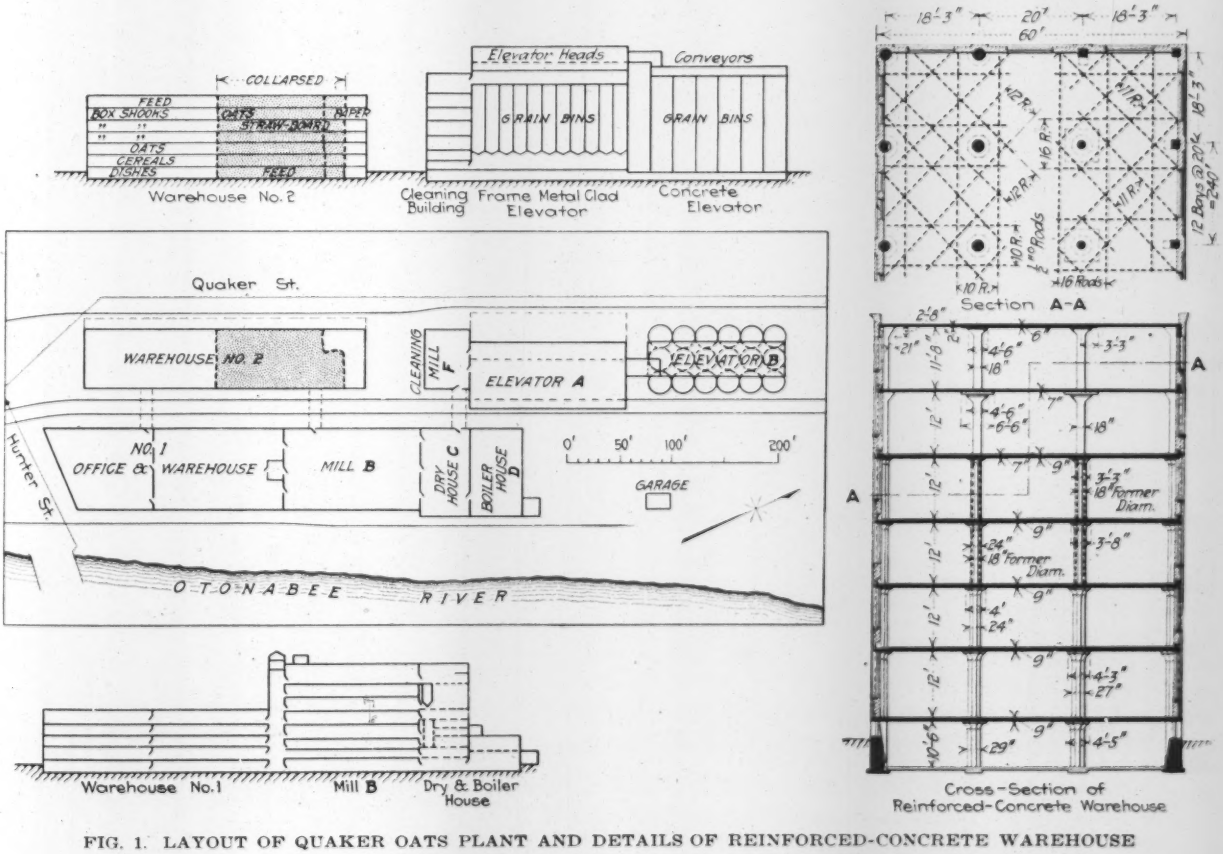
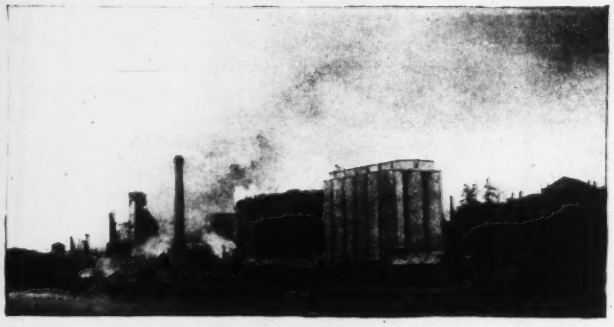


FIG. 1. LAYOUT OF QUAKER OATS PLANT AND DETAILS OF REINFORCED-CONCRETE WAREHOUSE

Concrete Warehouse All Ablaze

Looking West Toward Early Fire



Destruction Nearly Complete

FIG. 2. VIEWS TAKEN DURING PROGRESS OF FIRE

from grain bin. Reinforced-concrete warehouse (No. 2)—Six-story; flat-slab floors, with brick walls; 60 x 280 ft.; separated from cleaning mill by 60-ft. opening and connected by bridges and tunnels.

The entire property, with the exception of the reinforced-concrete warehouse (No. 2), the concrete grain elevator and certain portions of the drying building, was under automatic-sprinkler protection of the dry-pipe system, with the exception of the boiler house, which was equipped with the wet pipe. The reinforced-concrete warehouse was protected with wire-glass windows.

The reinforced-concrete warehouse was erected to a height of four stories in 1910, two upper stories being added in 1916. The earlier stories are of the flat-slab type designed at that time by the Leonard Construction Co., Ltd., which was the engineer and contractor for both parts of the building. The general design is shown in Fig. 1. When the upper two stories were erected, the diameter of the columns on the third and fourth stories was increased to take care of the additional load, by wrapping on expanding metal and pouring concrete to the new diameter. This floor—that is, the former roof—was increased from 7 to 9 in. in thickness by laying expanded metal upon it and pouring another 2 in. of concrete. The columns throughout the old floors were reinforced with separate steel hoops about $1\frac{1}{2} \times \frac{1}{4}$ in. section, placed on 8-in. centers. The new columns were spirally hooped. The earlier four stories had no drop panels at the top of the columns. The upper two, however, had drop panels except at the wall columns, where a bracket was substituted. In the corner columns these brackets were lacking. The grain elevator, the only other concrete structure, was of cylinder units of accepted design.

All concrete in the building was apparently of good quality, the aggregate consisting of a local gravel made up largely of limestone pebbles with a slight admixture of granite pebbles. The steel was covered with at least 1 in. and generally $1\frac{1}{2}$ in. of concrete.

Progress of the Fire

The fire was started about 10 o'clock in the morning by an explosion in the drying building. The explosion blew out the north and east walls of this building and uch of the firedoors as were not already open into the

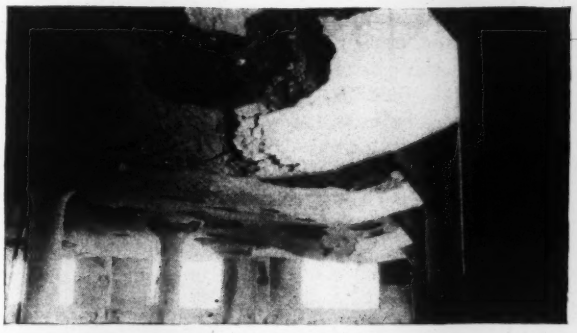
FIG. 3. WHAT IS LEFT OF THE CONCRETE WAREHOUSE

adjoining building. The walls in falling broke the steam connections to certain of the fire pumps and thereby greatly hindered the subsequent fire fighting. The fire spread very rapidly through the adjoining mill and was kept from breaking into the adjoining warehouse for some time by the wall and the firedoors, which the employees managed to get shut before the fire got that far. Meanwhile, the fire in Mill B fed on the very inflammable cereal content and raged strongly on all floors. Through various difficulties that it is not necessary to go into here, the water service failed to provide pressure enough to fight the fire effectively. For the same and for other reasons the sprinkler system worked at very reduced efficiency.

The fire soon swept through the group of buildings comprising the office, the warehouse, the mill for dry cleaning and the boiler house, all of which were of non-fireproof construction. About three-quarters of an hour

Cracks in Spiralled Column

Cracks Under Side Flat-Slab Floor



Sag in Floor of Wall Bay

Spalling in Concrete Ceiling

Typical Hooped Column

How Face Brick Melted

Peeled Enlarged Column

FIG. 4. DETAIL VIEWS SHOW DESTRUCTION INSIDE CONCRETE WAREHOUSE

after the beginning of the fire the contents of the reinforced-concrete warehouse caught, fire starting on the third and fourth floors, where there were large piles of box shooks. An attempt was made to close such of the wire-glass windows as were open on the exposed side and to get a stream of water on the blaze, and all except one window was closed. That could not be reached. The fire entered there, but soon became so intense that it broke through the other wire-glass windows.

The contents of this warehouse are shown in the diagram in Fig. 1. They were, with the exception of a few spaces in the basement, highly inflammable, and the fire became almost immediately beyond control. Almost blast-

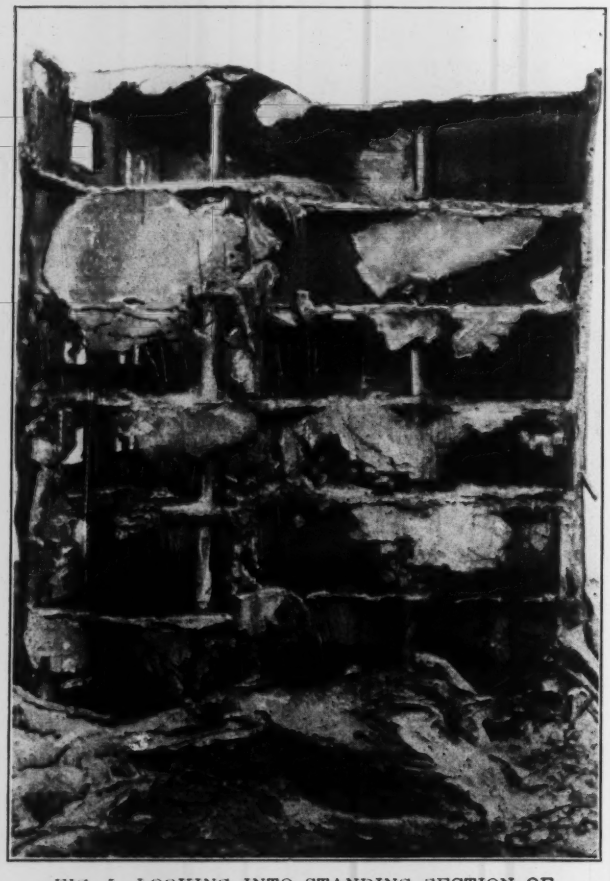


FIG. 5. LOOKING INTO STANDING SECTION OF CONCRETE WAREHOUSE

furnace conditions prevailed in the interior of this concrete building during the whole of the afternoon. Some of the accompanying views show fierce fires on every floor. Early in the fire the wire glass was hanging in sheets down the wall, and the steel window frames commenced to melt. The fire raged in this warehouse without any water being put on it until 6 p.m., when 6⅔ bays north of the center of the building collapsed. The position of these bays is shown on the drawing and general location of the building in some of the views.

All the buildings shown in Fig. 1, with the exception of the reinforced-concrete grain bins, were ruined by the immediate fire, and all except the concrete warehouse were completely destroyed. The grain bins were somewhat spalled in their lower 15 ft., and in one of the easterly bins a small hole was burned through the wall; but this hole was below the level of the floor of the bin, so that no damage was caused. Later, however, a fire smoldering along conveyor-belt passages beneath the grain bin caused an explosion that blew the top off one of the bins into the river. With these exceptions, the bins were not particularly damaged.

Intense Heat Melts Brick

The outstanding feature in the fire is the intense heat to which all the structures were subjected over a considerable period of time. In parts of the plant cast-iron car wheels softened and sloughed down into ellipses. Machinery parts melted and ran along the floors. Sash weights were melted out of all semblance to their original shape, and in one wall inside the reinforced-concrete warehouse the bricks melted and flowed down the face of the wall and along the floor like molasses for a distance of 18 in. This wall is shown in Fig. 4. It was a clay gray stock brick machine molded. It should be noted that the cement-mortar joints were only dehydrated and stayed protruding from the reduced brick face.

Concrete wherever it was attacked by the intense flame, was dehydrated to a considerable depth; but in no place could any fused concrete be found. Dehydration, however, completely destroyed the strength of the concrete and together with the reduced resistance of the heated steel reinforcement undoubtedly was responsible for the collapse of the midsection of the building. In other locations such concrete could be readily picked away with a small tool to a considerable depth.

The whole building expanded and contracted under the heat and subsequent cooling, as did the Edison buildings at West Orange, N. J., but the brick walls were not otherwise damaged except by minor surface spalling. As a result, diagonal cracks appeared along the face of the brickwork at ends of the standing portions. In one case, in the elevator penthouse of the building, the elevator guides, which came within an inch of the building, expanded so that they pushed up into the concrete floor slab forming that ceiling. The limestone facing of the building has been calcined in places to a depth of nearly a foot.

How Concrete Warehouse Was Damaged

In the reinforced-concrete building the collapse of 6⅔ bays out of 14 is complete through all the stories. In the remaining section, failure is incipient. Floor slabs have sagged throughout the building, as shown very definitely in the photographs. Columns are spalled, and walls are cracked. The salvage is practically *nil*. In his report on the damage to the concrete building, Mr. Mylrea says:

"Blocks of concrete may be readily broken off. At depths of about 1 in. the aggregate thus exposed shows no noticeable effect, unless it be of some coarse crystalline structure, such as granite. One such piece of granite as big as a man's fist was easily crushed by the grip of one hand. Closer to the surface the aggregate is calcined; the surfaces directly in contact with the fire were everywhere calcined from ¼ to ½ in., and on those blocks which fell into the fire in the collapsed portion calcination is practically complete. At no point is there any evidence of fusion of the aggregate in the concrete. At first glance

the material hanging from the cracks in the ceiling, shown in one view in Fig. 4, might be taken for fused concrete, but chemical analysis makes it practically certain that this is phosphatic material from 'Quaker Oats,' which was piled in cases on the floor above.

"All floors had been given a 1-in. wearing surface, and practically everywhere throughout the standing portion of the building this 1-in. surface has left the main slab.

"The reinforcing rods, even though protected in some cases with a very thin coat of concrete, were not oxidized until exposed. This might have been inferred from the fact that a thin coat of cement mortar will prevent rust, which is somewhat analogous to the black oxide formed on metal when subjected to fire; but whenever a slab failure occurs, the broken ends of the rods were drawn down as in any typical tension failure.

"That the shape of columns had something to do with the damage they sustained is evident, but the appearance of all the columns shown is very deceptive. The dehydration has affected the columns as well as the slabs and extends to well inside the circular hooping. Immediately after the fire, this was scarcely apparent, but the ensuing weather caused the appearance of the concrete to change considerably.

At first a freshly fractured piece of dehydrated concrete could scarcely be distinguished from a good piece, but the weakness soon became apparent, the mortar among the aggregate having more the appearance of dry blue clay. It is altogether possible that the hooping on the columns is largely responsible for their not failing. One view in Fig. 4 shows the partial failure of a column due to the spiral hooping not inclosing sufficient of the concrete and offers partial support to the statement just made. On all the columns, however, a few light blows with a hammer will detach large pieces of the concrete outside the hooping."

Condition of Gravel Concrete

In regard to the disintegration of the gravel aggregate under fire, the observer seemed to think that there was no breaking up of the gravel itself. The concrete failed from the separation of the mortar from the gravel. It should be remembered, however, that this gravel was not quartz, but was mainly of limestone pebbles with some granite pebbles.

The building was designed for a live-load of 200 lb. per sq.ft. On account of the location of the elevator and the ease of loading some slabs ahead of others, it seems probable that there was a considerable overload in some portions of the building. At the north end this apparently reached as high as 340 lb. per sq.ft. While the design of the building, particularly of the slabs, is not quite up to present-day practice, it was ample at the time the design was made and was in fact quite sufficient for any normal condition. The very intense heat to which the building was subjected makes negligible any discussion regarding the detail design or the safe loading under that design.

It appears, however, that the wall panels were not designed up to the loading capacity of the interior panels, which fact, together with the higher loading to which they were subjected, probably accounts for the greater sagging in the wall bays of the standing portion. One of the views in Fig. 4 shows how uniform is the sagging along a typical wall bay.

Contractors' Methods Differ on 166 Miles of Highway Work

Adequate Water-Supply and Reserve of Aggregate Near Mixer Lessen Number of Shutdowns and Save Time

AFTER studying the methods and equipment of nine contractors who are building 166 miles of hard-surfaced roads in Vermilion County, Illinois, P. C. McArdle, superintending engineer, has reached these general conclusions: An adequate supply of water is the first and most important consideration. A regular supply of material, with proper and sufficient equipment to unload and reload aggregate at the central station, is the next requisite. Proper transportation equipment—engines, cars and track—is the third. Of great importance, also, is a central-station dispatcher who can direct transportation and keep the trains moving on schedule.

FIG. 1. NARROW-GAGE Y CRAMPS STOCKYARD

Pumping Difficulties

On account of the apparently simple nature of pumping equipment, more difficulties arise from the necessity of furnishing an adequate amount of water, according to Mr. McArdle's findings, than from some of the more complicated transportation problems. To secure the supply required for the section covered by its contract, the

FIG. 2. DUMPING PROPER PROPORTIONS DIRECTLY INTO SIDE LOADER

Prendergast-Clark Construction Co. was forced to sink a 6-in. well, 125 ft. deep. Water from this source was supplied to the work through 20,000 ft. of 2-in. pipe. The Leader Iron Works, which manufactured the pump, estimated that, at 250 lb. initial pressure, it would deliver 12,000 gal. per hour through 15,000 ft. of clean pipe. At this distance the pressure would be but 15 lb. per sq.in.; and to insure a supply through the balance of the distance, a rotary booster pump, run by a 2-hp. gas engine, was

FIG. 3. EVERYTHING—EVEN THE BIN—IS ON WHEELS

installed at midlength of the pipe line. Near the point where work was being prosecuted, a 72-in. culvert pipe, 20 ft. long and closed at one end with concrete, was utilized as a reservoir. In this manner cheap storage was provided near the work for 4000 gal. of water.

How Industrial Equipment Is Handled

The unloading and reloading plants are all located at small towns or sidings and as near the center of the construction sections as possible. The outfit at Collison, on the Chicago & Eastern Illinois, is the second set-up for the Prendergast-Clark Construction Co., the first being on the Illinois Central at Armstrong. The plant and stock piles at Collison are cramped for room, as shown in the photographs, being located in the center of a narrow-gage Y. A stiff-leg derrick equipped with a three-drum engine and swinging engine operates a ¾-yd. bucket at the end of a 40-ft. boom. The device keeps two 20-yd. hoppers filled, either from new shipments or from the stock piles.

The procedure is to load 20 of the 1½-yd. cars from the hoppers and 20 more with the derrick, while the dinkey takes on coal and water. A train of 40 cars can be loaded in 15 min. under favorable conditions. While a record run of 1058 lin.ft. of 10-ft. pavement in 10 hours was being made, round trips to the job, 4½ miles away, were made in 2 hours. Seventy cars were used, all switching being done by a horse. The material was dumped on the subgrade and wheeled to the hopper of a concrete mixer, rated at 22 cu.ft. dry mix. This outfit made a record of 440 lin.ft. in 5 days.

The central plant of A. D. Thompson, at Jamesburg, parallels a siding and consists of two 60-yd. elevated hoppers, 30 ft. high, through which all aggregate passes. The bins rest on a framework of steel angles and channels so that the bin can be removed easily to a second station at Potomac. Sand and stone are elevated from a hopper under the railroad track by a bucket conveyor operated by an 8-hp. gasoline engine. Forty 1½-yd. cars and two engines make up the train equipment. The maximum haul is 4½ miles. Material is proportioned in the cars, which are dumped directly into the charging hopper of a side-loading mixer, the capacity of which is 27 cu.ft. dry mix, or 18 cu.ft. wet mix.

Some of the obvious advantages and troubles of dumping directly from industrial cars into the mixer hopper, as well as the possible remedies for the difficulties met with, were discussed by the superintendent and the county and state engineers. The greatest advantage arises from the fact that, as the material is not dumped on the subgrade, there is no danger of getting clay into the concrete. Further, a second handling by a shovel and wheelbarrow crew is eliminated, and the method makes possible an accurate measurement of material at the bins by filling the cars up to a definite mark. There is better protection of cement, as it is all kept at the central-station storage house or loaded direct from railroad to industrial cars.

The disadvantages of this scheme, as at present operated, are as follows: Lack of a storage "reservoir" at the mixer to tide over a period of temporary delays due to such things as a car jumping the track, switching difficulties and any hitch in the schedule of train movements. These are real difficulties, for it is estimated that the mixer has operated only about half-time. To maintain a suitable "reservoir" of material to keep the mixer going at a constant rate would require an estimated total of 90 cars plus the necessary track back of the mixer. This is 50 more cars than were actually provided and represents the added investment that would be required.

Several Remedies Are Suggested

This method involves other smaller difficulties, but they are gradually being eliminated. To lessen the number of derailments, it is desirable that the center of gravity be kept low; but despite this fact, springs have been put on some of the cars, raising them about 4 in., and the added

FIG. 4. FIRST LINE OF PILES CLEANED UP; TRACK IN SECOND POSITION

resiliency has considerably reduced the tendency of the cars to jump.

The cars do not dump out clean into the side loader, and two or three men are employed to scrape out the residue. Little or no time is lost, but the men are an added expense. An arrangement whereby the car body can be tilted over farther, using a cable from a crab on the mixer engine, is one method suggested; and another is to lay in the cars a piece of sheet metal that could be pulled out by the same means. The difficulty would be avoided if the cars could dump from a more elevated position. A small section of elevated trestle running on top

of the regular track has been suggested, but there would then be the difficulty of pulling the cars up the necessary incline, the shifting now being done by hand. A stationary incline was used at the concrete plant for the Chicago municipal-pier superstructure. Here a cable from a hoisting engine hauled the cars up the approach. The "mounted-trestle" scheme has been used in Detroit on the street-railway work, but it is an expensive outfit and so far has not been considered feasible for temporary trackwork.

Superintendent Watches Transportation

Some items of the equipment on other contracts are worthy of notice. The P. M. Johnston Co., of St. Elmo, Ill., working on a 20-mile section, unloads material from cars to home-made bins that discharge into 1½-yd. industrial cars. Two engines are provided, but the record for the season, 896 lin.ft., was made when only one engine was used on the road, the other switching the cars while they were being loaded. The maximum haul was 4½ miles, and a total of 60 cars was used. The material was dumped directly into a special side-loading mixer, rated at 33 cu.ft., wet mix.

On division 4 the Eclipse Construction Co. pays little attention to the mixer end of its outfit, that being left to a competent foreman, while the superintendent spends most of his time looking after transportation. With a mixer rated at 26 cu.ft. dry or 17 cu.ft. wet mix and charged from stock piles, the record for a 9-hour day was 952 lin.ft. One engine hauls the 40-car trains, though 20 additional cars facilitate progress. An unloader passes all material from bottom-dump cars by bucket elevator to a 40-yd. hopper.

Side Ditch Finished Ahead of Mixer

On section 7, handled by the Granite City Lime and Cement Co., an 11-cu.ft. wet-mix machine is charged with wheelbarrows from material dumped on the subgrade in two lines of piles. The first line of piles is deposited with the track laid to one side of the axis of the roadway, the piles being placed on the axis. The track is then shifted outside of the side form and the material dumped toward the roadway. On this contract all side-ditch grading is done and shoulders brought up to grade ahead of the mixer. This gives a substantial base for the second dinkey track and also permits traffic to compact the shoulder area before the macadam is finally placed.

To control the transportation, temporary telephone connections are made and the field box reinstalled every 1000 ft. Trains are made up of thirty 1½-yd. dump-cars hauled by a dinkey. Ten additional cars provide elasticity. Material is unloaded from cars to two 20-yd. hoppers or direct to the dump-cars by a portable derrick operating a ½-yd. bucket.

Panama Canal's Biggest Month to Date

A new record for the number of ships passing through the Panama Canal in a month was established in January. According to *The Panama Canal Record,* the total number of ocean-going ships making the transit, with which are not included local launches and vessels in the service of the Canal or of the army on the Isthmus, was 179. Their aggregate tonnage, Panama Canal measurements, was 557,839.

Civil Engineer Students Alternate Between Jobs and Classroom

At University of Cincinnati Boys Spend Two Weeks on Actual Work and Then Attend School Two Weeks

By G. M. BRAUNE

Associate Professor Civil Engineering, University of Cincinnati

MOST civil engineers know that at the University of Cincinnati the coöperative plan, by which the student alternates between practical work and classroom and laboratory study, has been in successful operation for some years, but as a rule they do not know that this principle has been extended to the civil engineering courses. Hitherto most of the publicity of the method has been devoted to the shop exchange plan in the mechanical engineering courses, but for some time past the civil engineers at the university have been successfully alternating between the collegiate course and drafting rooms, construction jobs, railway gangs and other practical work.

As the name implies, the coöperative course of education consists in coöperation between the university and commercial engineering organizations. In order that equipment shall be used fully, the student body is divided into two sections. While the first section is attending the university for two weeks, the second section is engaged upon outside work. Each student has an alternate, and the bi-weekly interchange is continued until the specific piece of work on which both are engaged is completed. In the mechanical and electrical departments this fortnightly alternation continues throughout the eleven months of school. In the civil engineering department, however, the first- and second-year students go to school full time from the beginning of January until the middle of April, on account of adverse weather conditions. The third- and fourth-year students continue the alternation during the winter months, as there are always enough desirable openings to keep them employed. The fifth-year, or senior, students attend the university full time from January until June, giving up their outside work during this period, in order to have sufficient time for their theses. During the summer months all the civil engineering students are engaged upon outside duties. The course, therefore, extends over five years of university and practical work.

Freshmen Get Real Jobs

The freshmen are placed as laborers with the railroads on trackwork, with construction companies working as helpers on carpenter, concrete, steel and sewer gangs, or on any construction work to which their employer may assign them. They also are placed in structural shops and on bridge erection. All outside work, however, must be approved by the professor in charge, both as to kind and sequence. The absolute minimum wage that the students receive on this class of work is 15c. per hour, and the usual pay is 20 to 30 cents.

This kind of work is continued into their second year and frequently throughout their second year, in order to give them a variety of experience. If they make good, they are promoted in their third and fourth years to

positions of timekeeper, material clerks and subforemen. In their fourth and fifth years they are given greater responsibility and are made foremen, inspectors and assistant superintendents. Those who desire to stay with the railroads are promoted to the engineering force. The wages of upperclassmen gradually increase, depending, of course, on the ability of the student. Fifteen to twenty dollars a week is the present scale. However, a few exceptionally able men are receiving more; for example, a third-year man is rated at $115 a month as assistant superintendent on a large piece of construction work.

When the students alternate as subforemen or inspectors, it would appear that a difficulty would arise in the alternation changes. This is avoided, however, through an arrangement whereby the student at the university gets in touch with his outside alternate on the Saturday preceding the Monday on which the shift is made. Quite a number of the civil engineering students are engaged upon valuation work for the railroad companies, doing both inside work and fieldwork. The railroads do not experience any difficulty at all in employing students on the alternate basis. In the United States Government work on river improvement, the changing in men due to the bi-weekly alternation operates without any difficulty.

The advantages of the coöperative system of education are recognized more readily by the practicing engineer than by the university instructor. The writer's viewpoint is that of an engineer who has had a university training, received partly in this country and partly abroad, followed by 18 years of practical experience and four years of teaching.

Faculty of Observation Developed

The motif of the coöperative course, as seen through the eyes of one enthusiast, will differ when expounded by another. One prominent educator and experienced engineer expressed his opinion that it was the practicality of the course that stood out so prominently. The writer believes that one of the most essential advantages is the forming of a *habit of observation*, or as Trautwine calls it, "that practical tact and *observation of outward things* so essential to a successful engineer."

In no other system of engineering education is there such an opportunity for exercising or creating this important faculty as in the coöperative system of education. In their coördination classes at the university the instructors are given an opportunity to discuss with the student's their outside work in all of its phases and to test a student's *observation of outward things*. As a result of the stimulus afforded by this classroom discussion, the student returns to his outside work with greater interest in its details, and observation soon becomes with him a matter of daily habit.

Many new positions are opening up for the civil engineer of the future that will require executive and administrative training. Especially will this be true in the construction of innumerable highways and in the management of county and municipal affairs.

Complaint is often heard, and justly so, of the inaccuracy of college graduates. Several years must elapse after they are in practice before they realize the responsibility of their work. A "coöp" knows that in order to hold his job with his firm he must be accurate. And this important point is hammered into his mind during the formative period. For instance, some of the students were assistants to the superintendent on a large reinforced-concrete building. Upon the coöperative student was placed the responsibility of giving correct figures for the formwork for the different floors. It was his duty to make daily distribution costs on which the superintendent relied for his knowledge of the progressive cost of the job. Thus he was made to realize the vital importance of accuracy.

Coöperative Method Builds Character

An incidental feature of the coöperative course that should not be overlooked is its value as a character builder. Undesirables do not remain long in a course of this kind, since "yellow streaks" are soon discovered through the dual check of the inside and outside work. The contact with outside affairs instils in the students an enthusiasm for the university work and brings forcibly to their minds the importance of theoretical training. It trains them to respect ability, from the general manager to the laborer, and to be considerate with their equals.

On the completion of five years of the coöperative course the student is a man trained in practical business methods as well as in theoretical work; he has confidence in himself; he has a knowledge of men; he possesses considerable tact; and he is ready for any kind of hard work. He has gone through the mill during his formative period when he was not ashamed to show his ignorance by asking simple questions. False pride, or fear of ridicule, is one of the most serious handicaps to a college graduate.

Technical Theory Not Neglected

There is a mistaken idea in the minds of some educators, and perhaps of some engineers, that the coöperative course tends to teach only a smattering of theory and that an attempt is made to train artisans. Such opinions are entirely foreign to the ideals of the system. The coöperative plan, on the contrary, not only gives a complete course in technical theory, as strong as that of any institution in the country, but is also attempting to give the students an opportunity to acquire general culture, through systematic talks by the professors of the Liberal Arts College, and a thorough course in English extending over the entire five-year period.

Special stress is laid upon ability to speak intelligently and correctly before a public body. In their Civil Engineering Club the students have an opportunity, which they are quick to grasp, to speak before a critical audience of 75 to 100 men, upon engineering topics with which their outside work has made them familiar.

One who exchanges the duties of a practicing engineer for those of a teacher of engineering is likely to feel that he is going to lose touch with the developments in his profession; that although he may keep his reading up to date, the little details of new methods will escape him. The writer has found that this is not the case, at least with the teachers of coöperative students. Through their daily contact with all kinds of engineering concerns, the practical problems of daily work and the useful applications of technical theory are kept constantly before him. For the instructor, no less than for the student, the coöperative plan has justified itself during its 10 years of operation.

System of Leasing Irrigated Land on Trial Benefits Both Settlers and Company

Under Plan Used Five Years on Washington Project Each Settler Soon Appraises His Chances of Success, and Continues or Retires

By ROBERT A. FOSTER

President, Lewiston-Clarkston Improvement Company, Clarkston, Wash.

FINANCIALLY embarrassed in 1912 because of its inability to sell its irrigated lands, the Lewiston-Clarkston Improvement Co., controlling about 5000 acres in southeastern Washington, instituted a leasing system whereby prospective settlers could satisfy themselves as to their ability to succeed with the land before buying it. In five years, the first of which was largely experimental, the company has developed a worth while and steadily growing source of income involving practically no expense; while the benefit to the settlers is equally marked—the unfit failing and being eliminated quickly without the loss attending actual purchase of the land, the fit paying for the land on the basis of its proved value. The leasing system, looking toward ultimate sale, has been applied to all the lands of the company. In the case of orchards the company or individual lessee has intercropped them with much success, the proceeds from these crops having paid nearly 85% of the cost of caring for the orchards. This intercropping, however, must soon be abandoned, as the orchards will produce a commercial crop in 1918. The system has proved so successful and so simple that it might well be tried on larger projects with lower-priced land.

In the State of Washington nearly all the land lying east of the Cascade Mountains and below an elevation of 1500 ft. above sea level requires irrigation to become of any considerable value for agricultural purposes. One of these areas deficient in rainfall, which is very small as to acreage, lies in the northeastern corner of Asotin County, the most southeastern county of the state, and lies west and south of the Snake River at that point. The irrigation of this particular section was undertaken in 1893 and brought to its present state by successor companies financed by the late Charles Francis Adams and his associates. Started originally as an irrigation company in 1893, it has undergone most of the vicissitudes that have overtaken many of the irrigation companies of the Northwest since that date, except that it has never been in the hands of a receiver.

Project Not a Large One

The area originally undertaken to be irrigated comprised about 3000 acres immediately adjacent to the Snake River, which at this point is about 725 ft. above sea level. The land is the rich volcanic soil peculiar to this section, and the mean annual rainfall is 13½ in. The source of water supply is Asotin Creek, which lies about 6 miles south of the land irrigated, and flows into the Snake River from the west. The irrigated land slopes to the northeast with an average grade of about 2½%, terminating in a low bluff at the river, at which point it has an elevation of from 750 to 800 ft. The original water supply commanded all that land having an elevation under the 1050-ft. contour.

In 1907 a new main conduit, 12 miles long, was built, bringing water in at an elevation of 1250 ft. above sea level. This brought about 4000 acres more land under the irrigation supply, but errors having been made as to amount and duty of the water, as well as to the suitability of the land for irrigation, it is probable that not more than 2000 acres of this additional 4000 acres will ever be irrigated. In fact even that much can be irrigated only with the most economical use of water by all now using it.

The land holdings of the Lewiston-Clarkston Improvement Co., which is the name of the company now holding title to the remaining lands, aggregate about 1000 town lots in Clarkston, a town of some 1500 people which has been developed along with the land; 346 acres of platted land in Vineland, as the first lands covered by irrigation were called; 502 acres of unplatted land adjacent to Clarkston and Vineland; 1258 acres of platted land on Clarkston Heights, a name by which the newer section on the second bench is known; 1800 unplatted acres adjoining Clarkston Heights, and 1130 acres on Asotin Creek, held to protect the water supply—making a total of a little more than 5000 acres, of which not more than 2000 acres will probably ever be irrigated. Of the 2000 acres which may still be irrigated, about one-half has been planted to apples, mostly of the Winesap, Rome Beauty, Jonathan, Yellow Newtown pippin and Spitzenberg varieties.

No Buyers for the Land

Along with other irrigation projects during the year 1912, this company found itself in financial difficulties owing to its inability to sell its irrigated lands. The theory of the promoter that arid land plus water meant wealth for all who would invest in either the development or the settlement of an irrigation project had been exploded, and the "survival of the fittest" stage had arrived. The projects which had undertaken to bring in bearing apple orchards were probably hit the hardest, since they had to face the financial strain, which they had expected to shift to other shoulders, of bringing in a bearing orchard. To pull out the apple trees meant a large investment must be written off as a total loss and the additional expense of removing the trees and planting to some other crop faced and financed.

This company, along with many others, was confronted with a serious situation, which according to the more skeptical required a drastic remedy. It fell to the writer to undertake the solution of the problem locally. The existing conditions were as follows: There were about 7000 acres under the project, of which about 3000 were being irrigated. There were about 2000 acres which

could be irrigated, of which about half were in apple orchard then two years old, and on which there had been spent as of Jan. 1, 1912, $13,398.99. If the company were to survive, that land must be made to carry itself.

The outlook was not bright, since about 1000 acres lay idle awaiting the coming of the settler, and another 1000 acres of apple orchard had required about $14,000 during the previous year to give it the care and attention deemed necessary by competent horticulturists.

Survey of Conditions Made

A survey of the conditions existing on the acreage already sold was undertaken to learn not only whether the settler was succeeding, but also whether any had found a solution which could be used on our large acreage.

The survey showed as to size that 1% of the tracts were less than ¼ acre, 6% were more than ¼ acre and less than 1¼ acres, 3% were more than 1¼ acres and less than 2 acres, 60% were more than 2 acres and less than 5 acres, 23% were more than 5 acres and less than 10 acres and 7% were more than 10 acres. This was probably the most intensive irrigation farming anywhere in the West.

As to ownership, 7% owned less than ¼ acre, 16% more than ¼ acre and less than 1½ acres, 4% more than 1¼ and less than 2 acres, 60% more than 2 acres and less than 5 acres, 12% more than 5 acres and less than 10 acres, and 1% more than 10 acres. This showed that 87% of the land was owned in tracts of less than 5 acres and that this holding represented about 70% of the acreage.

On tracts of less than ¼ acre it was largely a home proposition, which allowed a certain amount of vegetables to be grown to supplement their incomes. On tracts of more than 1¼ and less than 10 acres the living of the settler was almost entirely earned from the land. On tracts up to 1¼ acres chickens were principally raised. On those of more than 1¼ and less than 2 acres strawberries were the most successful crop, and all above 2 acres were for the most part orchards.

No solution of the company's problem was apparent from the study of what the successful settlers were doing. One thing only was apparent, and that was that the settlers were nearly all troubled, to use electrical terms, with a "peak load," which made their "load factor" too low. In other words, it was apparent that the high net return per acre which the land salesman had talked so much about did not necessarily mean and was not synonymous with a high return for the hours' work which the settlers had to sell. There were seasons when they could devote some of their time to the development of crops, which required less intensive cultivation than their "home" acreage.

Making Company Land Earn Its Way

To return to the company's problem, it was evident that the company land must be made to earn its way. An investigation of Government records showed that the value of irrigated crops per acre grown on land in the arid region such as might be grown here was as follows: Orchard fruits and grapes, $77; potatoes, $60; wheat, $23; alfalfa, $23; oats, $19; barley, $18, and corn, $18. These values were not directly applicable to this section, but were very helpful for comparisons. As land values in this section, less improvements, lie pretty close to six times the value of the annual crop produced, it was immediately apparent that the only crop that could be raised on land at the prices at which the company could afford to sell would be an orchard crop.

The original investment of the company per acre of land with water was about $175. The additional cost of developing an orchard to about eight years was estimated at $100 per acre, which would make a total investment at bearing of about $300. To realize on the investment the company would have to net about $500 per acre.

Intercropping the Only Solution

As the company had an apple orchard planted, and either orchards or garden truck was the only use to which the land could be put to make a profitable investment for a settler at the prices at which the company could afford to sell, and as the land was suited to that use and a market existed, there was no reason why any of the company's plans should be changed. There was no reason, therefore, why we should not go ahead with the orchard and get the undeveloped land into garden truck or other crops as rapidly as possible if we could make the land carry itself in the meantime. The undeveloped land could be put to any use desired. The only thing that could be done with the orchard to make it help pay for itself was to intercrop it.

To cut down the company expenses and outgo immediately, it was decided to lease such of our lands as we could, allowing the lessee to choose his own land and crop. A simple form of lease was drawn up and the length of lease made dependent on the crop grown—generally from one year for an annual garden crop to five years for alfalfa, where the lessee planted the alfalfa. The rental was fixed at one-third of the crop grown, delivered at the company's barns. That there was a surplus of labor was evident when a study had been made of how the time of the settlers was being spent.

By earnest solicitation a few settlers were interested in leasing land in 1912, and the company undertook to handle that year what land remained. About 750 acres of the unplanted lands were leased for the growing of wheat and alfalfa, and the remaining 250 acres were planted to alfalfa by the company. Of the 1000 acres in orchard it was possible to lease only a small part.

1912 an Experimental Year

The year 1912 was largely experimental in every way. The lessees were skeptical as to whether they could pay the one-third crop rental, and as to whether they could find the extra time necessary to farm the crops they had undertaken to raise. It was impossible to get more than a few to rent any of the orchard land on any terms, and of necessity the company was forced to operate the orchards itself. The results of this year, however, showed that the lessee could easily pay the crop rental, and the different kinds of possible intercrops that could be satisfactorily grown between the trees were determined upon.

Since 1912 the demand for lease land has increased with each year, so that the company now has a waiting list of settlers who desire to lease its lands. This leasing of the company lands has stabilized the entire project, and the earnings which different settlers have made from their leases from time which otherwise would

have been wasted have made the difference between success and failure in many cases. The example set by the company has encouraged other orchardists to intercrop their orchards, so that "two-story" farming is now almost universal. The company has furnished without any extra charge all the water necessary to grow any crop that the settler desired to grow, special emphasis being placed on getting the ground well soaked up in the late spring. Late spring irrigation was insisted upon, since the company depends on the stream runoff and does not have any storage. If the spring irrigation is properly attended to, the summer demand is of course made lighter. As there is excellent underground drainage, this project is in no danger of waterlogging any of the land under it.

Increased Earnings from Intercrops

The leasing system has given rise to increased earnings from the intercrops now universally grown, and from chickens, pigs and cows, which have greatly increased as to number because the leasing of company land has enable many to keep animals who otherwise could not. What has really happened is probably best told by the bank deposits of the principal bank of the town, which have been as follows: Dec. 31, 1911, $168,336.67; Dec. 31, 1912, $164,156.65; Dec. 31, 1913, $173,297.90; Dec. 31, 1914, $196,038.50; Dec. 31, 1915, $200,785.43; Nov. 17, 1916, $328,328.29.

The leasing system has made all the sales of irrigated lands which the company has made in the last few years either to the lessee or to his friends. The company has not since 1911 maintained a land-selling organization. What sales have been made have been made either as the results of inquiry at the company's office or through real-estate agents. About $100,000 worth of land has been sold in the last five years, and the commissions paid for its sale have averaged less than 3½%. These commissions are about all the expense really chargeable to the sale of land, since this land department is handled along with other work at this time. This is a great saving for the settler as well as for the company, when one considers that the cost of selling land in the past has been about 30%.

Earnings from Leases

The earnings of the company from leases against which there is no expense have been as follows: 1910, $2178.16; 1911, $3081.58; 1912, $4073.87; 1913, $4898.42; 1914, $7068.49; 1915; $6137.94, and 1916 (11 months), $7974.52.

As this is only the company's share, it means that about $20,000 more has been earned in 1916 by a few of the settlers who are also lessees. These earnings are only part of the benefit from this lease system, as the saving in cost of land sales is also a direct outcome of it. The slump in land-lease revenues in 1915 is due to a large land sale which was the direct result of leasing, and others are now pending.

Development Costs per Acre

In 1912 the company was forced, as before stated, to operate its own orchards, and it was largely an experimental year devoted to finding out what intercrops could be grown profitably. As a result of this intercropping, the development cost of about 1000 acres of apples has been as follows:

Date	Total Development Cost	Approximate Cost per Acre per Year
Jan. 1, 1912	$43,398.93	$11.00
January, 1913	51,851.44	9.40
January, 1914	58,568.42	7.64
January, 1915	63,760.55	5.77
January, 1916	67,283.18	5.91

These costs are arrived at by charging against the orchard development cost only actual orchard work. The farm department for the use of the land and the revenue resulting therefrom cultivates and irrigates the orchard at the same time that it tends its own intercrop. Notwithstanding the fact that only two-thirds of the land is available for intercrop, the farm department made a profit of $1998.11 for the year 1916.

Orchards in 10- and 20-Acre Tracts

The apple trees will be six years old in 1917, and will bear a small crop. The indications are for a very fair crop. The trees are healthy, and with more intensive care during the coming years should make a first-class orchard in every way.

The company is now preparing to lease these orchards in 10- and 20-acre tracts. As long as possible an intercrop of some kind will be grown. As an interesting sidelight, in three years a corn has been bred which, starting with a yield of about 15 bu., is now yielding better than 35 bu. to the acre, and is the most satisfactory of all intercrops which can be grown on a large scale, as the young orchard actually seems to be improved by such an intercrop.

By extending the lease system to the orchard lands it is hoped that the system will be as successful as it has been with the other company-irrigated lands.

Theory of Lease System

The underlying theory of the entire lease system has been to demonstrate the actual value of the lands. With the earning capacity once established it matters little whether the company sells or retains the lands as an investment. By establishing the selling value of its lands the lands should sell themselves, and the saving over past methods of sales will save from 20 to 25% to the settler in investment, making it correspondingly attractive, while the company will still receive as much net as under the old system.

Another distinctly important result of the system for irrigated lands is that it develops a set of men who understand that type of farming and automatically eliminates the unfit. This obviates the distressing conditions which have resulted in many irrigated sections from the settling up of projects with those who could afford to make the necessary first payments rather than with those who understood irrigation farming. It is only recently that people have come to appreciate that farming requires considerable knowledge, and that successful farmers must have as much business ability as successful men in other lines.

The leasing system has made it possible for this irrigation company to attract to the development and settlement of its lands the right type of farmer, and has resulted in building success out of its project, which under the old system of settlement-by-land salesmen had resulted in bringing disaster to the settler and the company alike.

Concrete Spillway Defects Caused by Construction Negligence

Examination of Many Structures Leads to Conclusion That Quality in Workmanship and Materials Is the Cure

By EUGENE LAUCHLI

Civil and Hydraulic Engineer, New York City

CONSTRUCTION details of apparently minor importance may become vital, in time, in the maintenance and safety of concrete spillway dams. These structures are coming more and more into use, and their lengths and heights are increasing rapidly. From time to time the question arises among engineers as to the advisability of facing the downstream, or spillway, side of concrete dams with a material less subject to wear and tear under severe duty than is ordinary cement concrete. As a matter of fact, several concrete dams abroad and a few masonry dams in this country have received an apron or shield of stone or artificial-masonry blocks, sometimes over the full width and length, sometimes only on parts of the spillway. In other instances methods have been adopted to decrease the velocity of the falling sheet of water, thereby increasing friction, by the creation of obstacles in the path of the flow.

Leaky Forms Cause Trouble

An examination of concrete spillway dams a few years old will readily satisfy the observer that poor workmanship and materials soon result in corrosion. The disastrous effects noticeable in Figs. 1, 2 and 3 can be traced directly to (a) leaky forms; (b) day's work planes; (c) horizontal lift joints; (d) vertical joints at butting surfaces of forms. Construction engineers are familiar with the fact that, when forms are raised, the lower end, instead of bearing firmly throughout its length against the more freshly laid concrete, lies from $\frac{1}{16}$ to $\frac{1}{2}$ in. away from it, due to the unevenness in the concrete and the swelling, yielding and warping of the wooden forms.

Thus the face of the dam, instead of being left smooth after its completion, has the somewhat exaggerated stepped appearance illustrated in Fig. 4. The cement leaking between the planking of a set of forms creates longitudinal voids, spaced 8 to 12 in. apart—that is, the width of the planking. The velocity of a falling sheet of water creates a vacuum at points where the water does not adhere to the spillway's face, and corrosion takes place rapidly. The resulting damage is not confined merely to the surface of

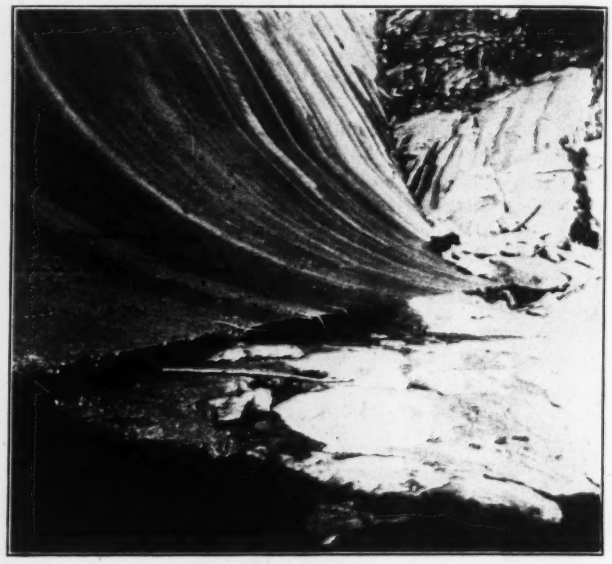


FIG. 3. DOWNSTREAM FACE OF DAM 100 FT. HIGH. TWO YEARS IN SERVICE

Note corrosion at lift joints, also that toe of structure has been undermined by corrosion. Stick of wood extends 2 ft. under concrete

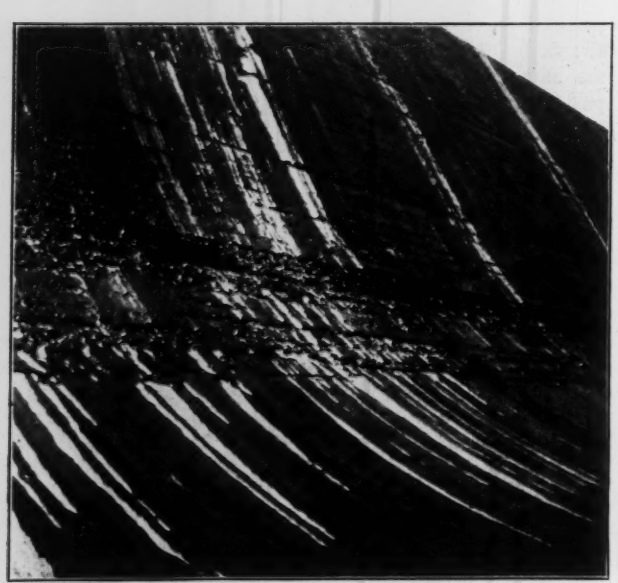


FIG. 1. DOWNSTREAM FACE OF 50-FT. DAM, 10 YEARS IN SERVICE

Note corrosion at lift joints, also at joints between planking of forms. Lower or curved part of dam was given a new coating of cement mortar after several years' service

FIG. 2. DOWNSTREAM FACE OF 50-FT. DAM, 10 YEARS IN SERVICE

Note corrosive effects on two different concrete mixtures, one at the right richer than that on the left-hand side. Cavities on the left, from 2 to 2.5 ft. deep

FIG. 6. DOWNSTREAM CURVED PART OF SPILLWAY DAM
"Thin lip" at joint elevation could not resist crushing effects of débris falling over crest of dam

FIG. 8. DOWNSTREAM FACE OF SPILLWAY DAM
Plums kept too near to surface, and concrete covering them washed away by flow of water over surface

the concrete, but by observations it has been found in various cases to extend 2 ft. or more beneath the surface, as illustrated in Figs. 2 and 3.

Laitance and Defective Construction

Another source of trouble is to be found at lift joints, and more especially at the lower or curved part of spillways. Concrete, laid too wet in many instances, generally assumes a plane surface at the end of a day's work, and laitance forms a blanket upon it. Good practice calls for the removal of laitance before laying fresh concrete, either

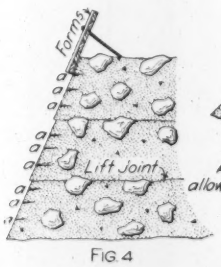


FIG. 4

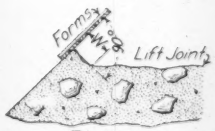


FIG. 7

At "a" leaky forms allowed cement to escape

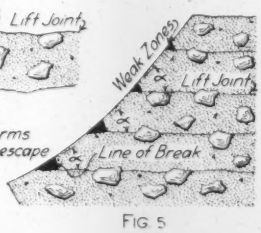


FIG. 5

by picking the surface or other adequate means. Unfortunately, that part of the concrete lying nearest to the forms of a lift joint on the downstream side is somewhat difficult to clean, on account of the sharpness of the angle *a*, Fig. 5, so that there is usually a tendency for laitance to be left untouched at this point.

Now, corrosion finds an easy prey in soft and cohesionless materials, such as laitance deposits, and voids similar to those illustrated in Figs. 1, 2, 3 and 5, are soon formed; it then takes but the shock caused by débris falling over the dam's crest to cause the unsupported part of the concrete to break along a line, as shown in Fig. 5, thus resulting in the ugly appearance of Fig. 6. As a remedy against this defect the method indicated in Fig. 7 is suggested. It consists in using a relatively dry, but well-spaded concrete, sloping toward the body of the dam, thereby causing two adjacent lifts to butt against each other at *W*. Incidentally, laitance would not accumulate on the sloping surface *W* at the end of a day's work.

Another source of trouble is caused by allowing plums to be laid too close to the surface of a structure; fortunately, this defect is found chiefly in older dams, as modern specifications usually state definitely the distance at which the plums are to be kept from the face. If too thin a body of concrete is provided to cover the plums, or embedded stones, expansion and contraction cause cracks at the surface. Then, too, débris falling over the crest of the dam causes this thin coating of concrete to break under the shock, and the next freshet washes away the

FIG. 9. PLUMS TOO NEAR SURFACE
Corrosion loosening plums at right-hand lower corner. Specimen marked "A," 2 ft. long, 10 in. wide and 8 in. thick, completely loosened

FIG. 10. EROSION AT TOE OF DAM 100 FT. HIGH, TWO YEARS IN SERVICE

Concrete mixture, 1 : 2.5 : 5. Note unevenness of eroded surface

débris, thus leaving an uneven surface having an appearance as in Fig. 8.

Corrosion soon attacks uneven surfaces, especially at the lower end of a spillway dam, where the velocity of the falling nappe is high; and thus, little by little, the plums become loosened, as shown in Fig. 9. Plastering or "patching up" the downstream face of a spillway dam always remains a "patch job," as the continuous changes in temperature cause the mortar to crack; and however tiny these cracks may be, corrosion completes the job.

Contrary to expectations, erosion does not seem to have immediate disastrous effects on concrete—that is, if compared with those due to corrosion. Water must have a high velocity, or else be very gritty, to attack concrete. In general, high spillway dams form large reservoirs; and the suspended matters in water are deposited usually at the head of the reservoir, so that water spilling over the structure is usually free of gritty matter. From Fig. 10 it is apparent that erosion does not take place evenly over the concrete surface, and thus recesses or cavities are formed. Here again corrosion is walking in the footsteps of erosion.

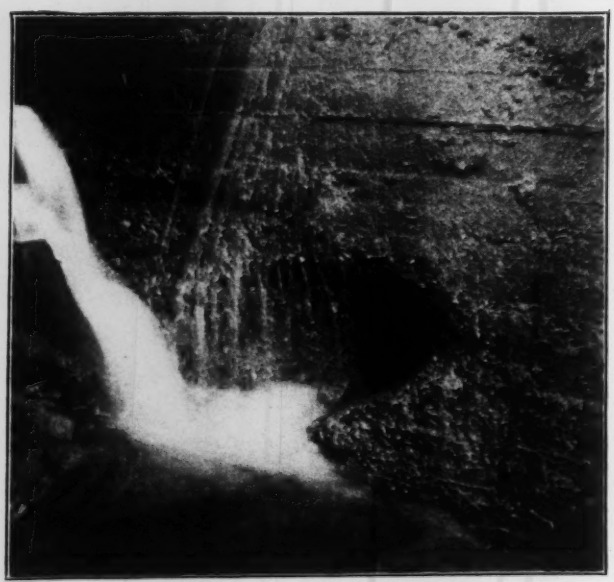


FIG. 11. EROSION IN FACE OF DAM TWO YEARS IN SERVICE

Cavity 2 ft. long, 15 in. wide and 10 in. deep

Sometimes obstacles located too close to the toe of a spillway deflect the flow of the falling sheet or cause waves and whirlpools whose churning effects become the cause of rapid and localized erosion, as illustrated in Fig. 10, for instance.

Conclusions

Further observations of spillway dams in operation will decide whether high structures should be provided with a facing of rich concrete, masonry or artificial-masonry blocks—at least at the lower or curved part of the downstream face—in order to increase the life of these structures, or whether their width should be increased to provide for future defects. Let it be hoped, however, that an increase in quality of both workmanship and materials will be favored rather than increase in yardage, the bulk of which renders adequate inspection of materials and of construction operations and forms almost impracticable from the contractors' point of view.

There are plenty of masonry dams half a century old, built along slender and yet conservative lines. Quality in workmanship and materials has permitted these structures to stand. Let us, therefore, place our main reliance upon quality.

Iowa Commission Favors Road Patrol

The Iowa State Highway Commission, in its 1916 report, states, as a result of its investigations, that the demand is for serviceable roads in all parts of the state, rather than for a limited mileage of high cost road. This demand can be satisfied within a reasonable expenditure of money only by constant and systematic maintenance of the earth or other form of low cost roads. No equal expenditure of road funds for other work will give half the service to the public that will the money spent for adequate maintenance. The Commission is of the opinion that the only way in which adequate maintenance can be secured is through the patrol system. The cost of such a system should be about $100 per mile per year. During 1915 the maintenance on the county roads cost $74 per mile and yet the roads were not satisfactorily maintained. Under the patrol system the responsibility for the condition of any mile of road can be definitely fixed. Under the present system the responsibility cannot be so fixed. The present system of maintenance breaks down when maintenance is most needed.

The Commission recommends a law establishing the patrol system of maintenance for county roads. Such a system would increase the cost of maintenance possibly 25%, but it would insure the upkeep of the roads. This system need not increase the present road expenditures, for the county funds are now ample to cover the cost of patrol maintenance. Under such a system only can the service from our roads that we are now demanding be secured.

Standard Plans Solve Problem of State Highway Bridge Supervision in Illinois

Systematized Methods of Design and Approval Make Possible the Construction of 15,000 Drainage Structures of All Sizes and Types Each Year

By CLIFFORD OLDER

Bridge Engineer, Illinois State Highway Department, Springfield, Ill.

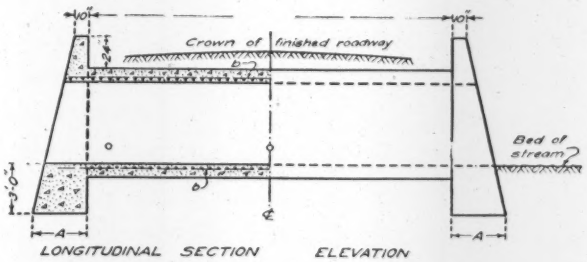
SYNOPSIS—The Bridge Bureau of the State Highway Department must design or approve several thousand bridges and culverts per year. Standard plans offered the only means of handling this mass of work. Nearly a hundred standard sheets have been made; most of them were reduced to zinc etchings, so that thin-paper press prints can be used direct or after drawing on additions.

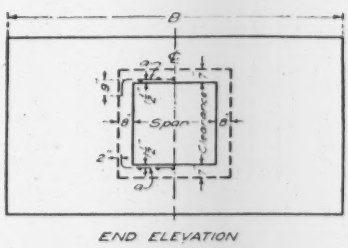
BY LEGISLATIVE enactment a State Highway Commission was created in Illinois in 1905. One of its duties was to investigate all matters pertaining to roads and bridges which might have a bearing on the needs of the state in this connection.

This investigation soon brought out the surprising fact that the highway bridges absorbed nearly one-half of the total funds which were then available for road and bridge purposes. Further investigation showed that a vast improvement was possible, not only in the administration of highway bridge matters but also in the construction of the bridges. An active educational campaign was then started to promote the needed improvement. This campaign was continued until a few years ago, when it became evident that this matter had become so generally understood that special efforts were no longer necessary.

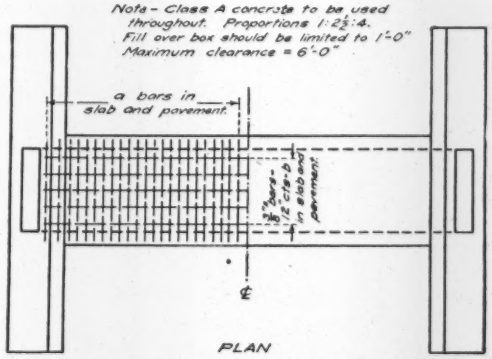
In the meantime, the campaign for better bridges induced calls for bridge plans, estimates and specifications, which grew so rapidly that it proved a difficult problem to develop means for satisfying the demand. In 1913 the passage of the Illinois Revised Road Law, which placed to a considerable degree the control of highway bridge construction in the hands of the State Highway Department, added greatly to the calls for bridge plans. That

STATE OF ILLINOIS
STATE HIGHWAY DEPARTMENT
CONCRETE BOX CULVERT.





Note - Class A concrete to be used throughout. Proportions 1:2½:4. Fill over box should be limited to 1'-0" Maximum clearance = 6'-0"



SHOWING REINFORCEMENT. SHOWING OUTLINES.

BILL OF MATERIAL

Design	Span	Clearance	Width of Footing A	Length of Head Walls B	Reinforcing Steel: Bars	No.	Size	Cts	Length	Steel Lbs.	Concrete Cu. Yds.
1	5'-0"	1'-6"	2'-0"	11'-0"	a		½"	5½			
					b		⅜"	12"			
2	5'-0"	2'-0"	2'-3"	12'-6"	a		½"	5½			
					b		⅜"	12"			
3	5'-0"	2'-6"	2'-3"	14'-0"	a		½"	5½			
					b		⅜"	12"			
4	5'-0"	3'-0"	2'-6"	15'-6"	a		½"	5½			
					b		⅜"	12"			
5	5'-0"	3'-6"	2'-9"	17'-0"	a		½"	5½			
					b		⅜"	12"			
6	5'-0"	4'-0"	2'-9"	18'-6"	a		½"	5½			
					b		⅜"	12"			
7	5'-0"	4'-6"	3'-0"	20'-0"	a		½"	5½			
					b		⅜"	12"			
8	5'-0"	5'-0"	3'-3"	21'-6"	a		½"	5½			
					b		⅜"	12"			
9	6'-0"	1'-6"	2'-0"	12'-0"	a		⅜"	6"			
					b		⅜"	12"			
10	6'-0"	2'-0"	2'-3"	13'-6"	a		⅜"	6"			
					b		⅜"	12"			
11	6'-0"	2'-6"	2'-3"	15'-0"	a		⅜"	6"			
					b		⅜"	12"			
12	6'-0"	3'-0"	2'-6"	16'-6"	a		⅜"	6"			
					b		⅜"	12"			
13	6'-0"	3'-6"	2'-9"	18'-0"	a		⅜"	6"			
					b		⅜"	12"			
14	6'-0"	4'-0"	2'-9"	19'-6"	a		⅜"	6"			
					b		⅜"	12"			
15	6'-0"	4'-6"	3'-0"	21'-0"	a		⅜"	6"			
					b		⅜"	12"			
16	6'-0"	5'-0"	3'-3"	22'-6"	a		⅜"	6"			
					b		⅜"	12"			
17	6'-0"	5'-6"	3'-3"	24'-0"	a		⅜"	6"			
					b		⅜"	12"			
18	6'-0"	6'-0"	3'-6"	25'-6"	a		⅜"	6"			
					b		⅜"	12"			

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FIG. 1. A WIDE RANGE OF CONDITIONS MAY BE COVERED BY THIS CULVERT STANDARD BY COMPLETING THE BILL OF MATERIAL FOR VARIOUS LENGTHS

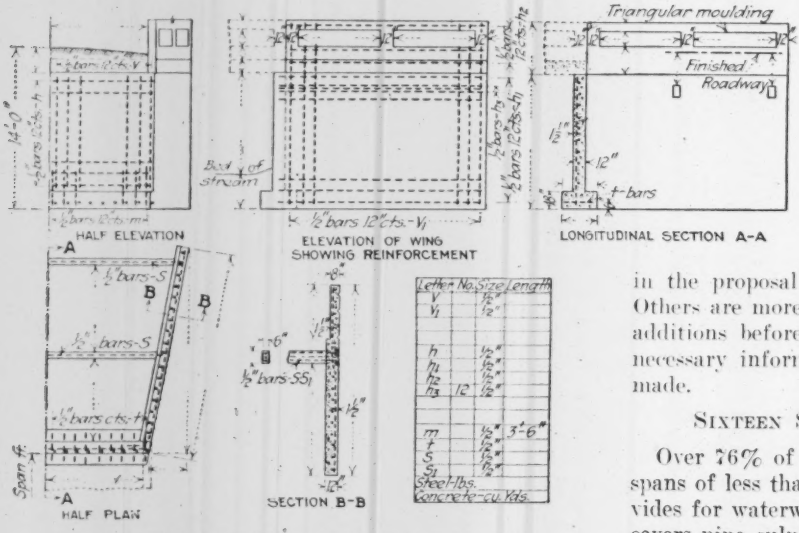


FIG. 2. AN ABUTMENT STANDARD FOR A REINFORCED-SLAB BRIDGE

One sheet of Group 2; earth pressure on wings partly resisted by ties across roadway

the providing of plans for such structures as fall under the control of the State Highway Department has become a serious problem, may be appreciated when it is understood that approximately 15,000 drainage structures of all sizes and types are built in the state each year.

Loading Conditions Fairly Uniform

The development of standard plans started with practically the first bridge plans prepared. From the first it was recognized that rigid adherence to any set of fixed standard plans could not be considered the best engineering practice, and a rule was established to the effect that proper design must not be sacrificed in order that standard plans might be used. In highway work, however, the legitimate use of standard plans may cover a much broader field than is the case in many other lines of engineering work. Because of the comparatively light grading which prevails, but few drainage structures are covered by fills deeper than the minimum necessary to provide for a wearing surface. This results in conditions of loading which are fairly uniform for culverts as well as for bridges. The uniformity of the topography of large areas of the state leads to many possibilities for the duplication of structures.

These are the general conditions which have made the development of a somewhat elaborate series of standard bridge plans a possibility, as well as an economic necessity.

Size and Character of the Standard Drawings

In preparing the standard plans, tracings were made on sheets trimming 22x28 in., and 21x27 in. between margins. Special care was used to insure that all figures and letters would be legible and all lines distinct when reduced one-half. Ample room was also allowed for lettering dimensions, notes and other information on the reduced plans. From these tracings one-half size zinc etchings were made.

Printing-press prints from the zinc blocks, on thin paper of good quality, 11x15¼ in., provide an ample binding margin at the left (11-in.) side. The specifications used are in book form and measure 11 x 8½ in. The etching prints, or blueprints made from them, when folded once conform as to size with the specifications to which they are clamped. Certain of the etching prints show in complete detail all information necessary for the work, and when such is the case they are attached to the specifications and are referred to in the proposal sheets by the number of the standard. Others are more or less incomplete and therefore require additions before they may be used. In such cases the necessary information is added by hand and blueprints made.

Sixteen Standards Provide for Culverts

Over 76% of all drainage structures in the state have spans of less than 9 ft. A series of sixteen etchings provides for waterway areas from 1 to 50 sq.ft. This series covers pipe culverts with end walls suitable for farm entrances; pipe culverts with end walls suited to cross-road culverts; semicircular arch culverts of the same two classes; box culverts for farm entrances; cross-road box culverts with reinforced-concrete top slab, paving, side and end walls; and cross-road culverts having plain concrete walls with the top slab and paving only reinforced.

In addition, three etchings are provided for culverts to be built under fills, with all dimensions, size and spacing of reinforcing material, etc., left blank. They serve only to save the time necessary to make drawings.

To illustrate the means whereby the sixteen culvert etchings are made to cover practically all necessary variations in waterway and length of barrel, a description is given of the method used to develop the wide range of conditions covered by the prints from one of the four etchings representing box culverts with plain concrete walls and reinforced slab. The four etchings mentioned are standards 748, 749, 750 and 751 (numbers marked near lower right-hand corner). The development of standard 749 (Fig. 1) will be described.

The variables shown on the drawing are: Width of roadway, length of end walls, thickness of end-wall footing bases, span, clearance and cross-section, number, spacing and length of reinforcing bars. With the exception of width of roadway, these are either lettered or named. The bill of material shows eighteen different designs, which cover spans of 5 ft. and 6 ft. and clearances varying by 6 in. from 18 in. to a maximum equal to the span length. As the length and base thickness of the end walls, and the cross-section and spacing of the main reinforcing bars, are dependent only upon the span and clearance, these items are scheduled in the bill of material for each design. The number and length of reinforcing bars, total weight of steel and total volume of concrete are dependent upon the width of roadway.

To complete the range for which this standard is available, on an etching print is lettered a standard width of roadway, the corresponding bill of material is completed for each of the eighteen designs and the etching print is given a "substandard number" such as 749-1. The etching print is thereafter known as "substandard seven forty-nine dash one," and blueprints therefrom show all information necessary to construct culverts of the type and width of roadway provided by this substandard and with eighteen

different combinations of span and clearance. Other prints are filled in for all of the various standard roadway widths.

With some variation, this general scheme is applied to the prints from the other fifteen culvert etchings. From the etching prints, complete drawings are thus made which provide for a very wide range of conditions. The completed system of substandards represents more than 1000 culvert plans, differing from each other in type of construction, shape or area of waterway, length of barrel, or design of end walls. The selection may quickly be made by reference to classified index sheets which give the standard and substandard number, and also the total quantities of steel and concrete.

In making up road plans, conventional signs and station numbers are used to show the location of culverts. They are described by indicating the standard, substandard and design numbers, which together with the quanti-

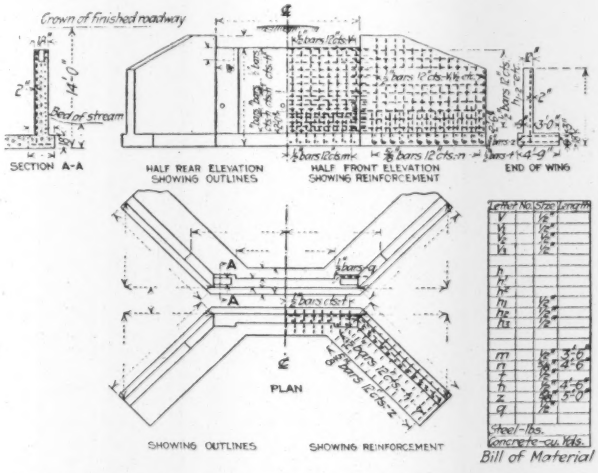


FIG. 3. TYPICAL STANDARD ABUTMENT FOR A CONCRETE GIRDER BRIDGE; CANTILEVER TYPE

ties needed for estimating purposes are taken from the index sheets. The actual substandards are thus not needed until the work is advertised. Blueprints are then attached to the road plans together with a schedule of the culvert designs to be used.

Concrete Slab Standards Cover 165 Designs

Eleven standard plans cover reinforced-concrete slab superstructures. They provide for clear spans of from 10 to 30 ft. varying by 2 ft.; clear roadways of 16, 18, 20, 24 and 30 ft.; and guard rails of three different types. The drawings proper of each sheet provide for a single span length, and show complete details and dimensions with the exception of items dependent upon width of roadway. Three different types of guard rail, distinguished by the letters A, B and C, are also detailed on each etching; they provide for variations in ornamental effect. Bills of material are given for each of the three guard-rail designs and for widths of roadway of 16, 18, 20, 24 and 30 ft. These fifteen bills of material (all on the sheet) complete the information necessary to construct superstructures having any of the widths of roadway mentioned and any of the three types of guard-rail provided.

The etching prints may then be used without blueprinting, providing the prints are marked with the width of roadway and type of rail desired, or if these items are otherwise specified. Usually, however, to reduce the probability of error, a single print is marked with the width of roadway, type of rail desired, and a title stamped in a small printing press; blueprint copies are then made.

The eleven drawings for slab superstructures (spans 10 ft. to 30 ft. inclusive) provide for 165 designs, complete in all details, each differing from the other either in length of span, width of roadway or type of guard rail.

Concrete Through-Girder Superstructures

A series of twenty-four standard plans covers clear spans of 30 to 65 ft. varying by 5-ft. intervals, and roadways of 16, 18 and 20 ft. Wider roadways are not often required, and, when demanded, the conditions frequently are such as to render deck-girder or arch designs more economical or otherwise more desirable.

Each standard provides for but one span length and one width of roadway. This permits showing all information—including a bill of material—necessary for the construction of the superstructure. Either the etching prints or blueprints therefrom may be used, without alteration or additions except when a title is necessary.

The preparation of plans for plain concrete abutments is so simple that only two etchings have been provided, one to accommodate slab and the other girder superstructures. These standards show outlines, blank dimension lines (except for a few fixed dimensions) and a space in which to show the quantity of concrete required.

In using these standards a draftsman computes all dimensions and quantities and adds this information to an etching print, which is then blueprinted for use. The etching prints in this case save merely the time necessary to make drawings. As such drawings may not be scaled, sufficient dimension lines are provided to completely define all parts of the abutment.

Reinforced Abutments Not Easy To Standardize

The preparation of standard plans for reinforced concrete abutments for slab and girder bridges presented considerable difficulty on account of the large number of variables involved. The saving in office work, however, justified the preparation of about fifty etchings.

This series includes four groups of standards, showing all information which is independent of length, angle and slope of wings, and design of the superstructure. Group 1 includes standards for reinforced abutments for slab bridges with wings designed on the cantilever principle. Group 2 covers abutments for slab bridges similar to the U-type with wings restrained near the top by ties across the roadway. Groups 3 and 4 correspond with 1 and 2 in type, but are arranged for through-girder superstructures. Figs. 2 and 3 illustrate typical standards of Groups 2 and 3 respectively.

Each group consists of a series of standards providing for over-all heights varying from about 9 to 20 ft. by intervals of 1 ft. For abutments less than 9 ft. high, plain concrete is practically always cheaper than reinforced concrete. Calls for heights greater than about 20 ft. are not frequent, particularly for slab bridges.

To use these standards, an etching print is selected which provides for the desired type and over-all height,

and on this sheet is lettered the information necessary to adapt the standard to the particular superstructure design selected and that necessary to define the location, elevation and the length, angle and slope of wings. The bill of material is then completed. No structural designing is necessary, as all structural features not fixed on the etching prints are taken from tables.

In lieu of substandards, whose number would be prohibitive, a record card for each abutment standard is kept on which is entered a record of each superstructure with which it is used, and the identifying number of the bridge. By reference to these cards it is possible quickly to determine whether or not a given standard has previously been used for the same conditions. If so, by means of the bridge number, the plans are readily located in the files and copies made on new etching prints, thus simplifying and expediting the work.

Infrequently Used Standards on Tracing Cloth

The standard plans so far described have all been engraved and press prints made. But many other standard plans are not used often enough to justify the expense of procuring zinc etchings. Among these are plans for steel superstructures, plain and reinforced concrete abutments for steel bridges, abutments of unusual height for slab and girder bridges, and others. These standard plans are maintained as tracings. As these measure 22x28 in. between trimming lines, blueprints folded on the one-third lines each way correspond in size with the specifications.

On these tracings variable dimensions, quantities, etc., are left blank. To adapt these standards to a particular bridge, a "cover sheet" of tracing cloth is laid over the standard and matchmarked, the blank dimensions, quantities, etc., and the standard number are lettered on, and a title and the designating number of the bridge printed on. This sheet is pinned to the tracing of the standard when blueprints are made, and the blueprints then appear as complete drawings. The standard tracings and "cover sheets" are filed separately, but may easily be assembled at any time when prints are desired. This system is but little less convenient than one in which etching prints are used.

Experience with Standard Plans

In general, standard plans have been found to save a great amount of time otherwise needed to make computations and drawings, many times duplicated; promote uniformity and consistency of design; tend to eliminate errors of oversight; reduce the possibility of errors in computation, because many features of each standard design are fixed; and, because of the uniform arrangement of the drawings and methods of dimensioning, facilitate construction and inspection.

Their principal disadvantages are the tendency to use standard plans when special designs may be needed to fit conditions at the site; the impracticability of arranging standard drawings so as to permit general scaling; and the inertia necessary to be overcome in order that the standard plans may be kept abreast of modern practice.

The use of prints from zinc etchings as compared with the tracing cover-sheet system presents the advantage of having complete information on each sheet of the drawings, rather than on cover sheets which must be matched with the proper tracings when duplicates are desired. In addition, prints of the same standard may be used by several draftsmen at the same time, which is not possible with the standards made on tracing cloth. The etching prints, when complete in themselves (as for instance those for the through-girder superstructure standards), may be used without blueprinting. These items, although seemingly small, are of great importance when a large volume of work must be handled.

Although the standard plans in use cover a wide range of conditions, it has been found that special or supplementary drawings are necessary for about 25% of all bridge designs.

The Year's Work in 1916

During the year of 1916, the office force of the Bridge Bureau of the Illinois Highway Department prepared plans and specifications for a total of 4597 highway drainage structures, checked by mathematical computation and comparison with tables 653 bridge plans prepared by other engineers, and checked the detailed shop drawings and made shop inspection of all steel bridge work under construction. In addition, a considerable number of standard plans were prepared.

During the single month of April, 1916, plans and specifications were prepared for 1447 drainage structures. At that time sixteen draftsmen were employed. It may readily be understood that without an elaborate system of standard plans this result would have been impossible of attainment.

Including the entire office payroll of the bureau of bridges, which includes stenographers and blueprint clerks, plus 15% for general office overhead and making no deduction for the time used in checking the 653 plans submitted for approval, or for the checking of shop drawings and making shop inspection of steel work, the cost of preparing bridge plans and specifications amounted to 1.47% of the estimated cost of the structures for which plans were prepared. This figure is reduced to 0.97% if to the preparation of bridge plans is charged only the cost of the office engineering force engaged on this work, and a proper allowance is made for the cost of checking plans prepared elsewhere.

By the use of the system of standards described, it has thus been possible to hold the cost of preparing plans for a large number of small units of work, estimated to cost in the aggregate more than 1½ million dollars, to a figure which compares favorably with the cost of preparing plans for large units of construction.

Over Fifth of All Fires Preventable

Based upon an analysis of the annual report of fire losses in the United States for 1915, issued by the Actuarial Bureau of the National Board of Fire Underwriters, the Fireproof Construction Bureau of the Portland Cement Association reports that 21.3% of the fires may be considered as preventable, 38% are probably preventable, and the causes of 40.7% are not known. The total losses for 1915 amounted to $153,231,876—which may be divided into a little over $61,000,000 loss on buildings and approximately $92,000,000 on contents. These figures represent insurance losses only. The fire losses were approximately $200,000,000, of which about $153,000,000 was covered by insurance.

How The Delaware and Hudson Is Handling Its Valuation Fieldwork

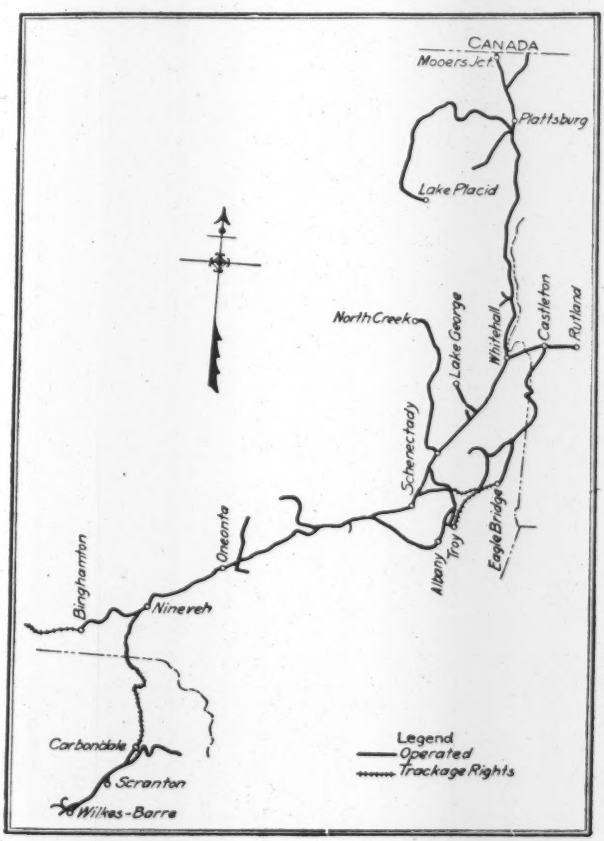
By Independent Surveys, and Surveys Made Jointly with Government, Company Is Compiling Unusually Complete Record of Its Permanent Way

By GEORGE H. BURGESS

Chairman, Valuation Committee, The Delaware and Hudson Company

FIELD SURVEYS that in addition to fulfilling the requirements of the Government are giving the company a most complete and valuable set of records of its permanent way, such as it never before possessed, are being made on the lines of The Delaware and Hudson Co. In part, these are independent surveys, being carried out in advance of the Government's arrival; in part, they are joint surveys, in which Government and railroad men are working together amicably, getting all the data required by the Division of Valuation and incidentally much additional information useful to the company in a variety of ways.

Alignment and profiles are being carefully run, and the cross-sections are being referred to datum. In the office the company is working the data up into maps of the uniform size prescribed by the Government, and of uniform scale, except where station maps require an enlarged scale. The cross-sections are also plotted to a convenient scale on standard cross-section paper. Aside from affording such a check on the Government's figures as is not possible when the carrier has only pilots and computers accompany the Government parties, and providing data of use in determining original conditions, a result entirely independent of the valuation work will be that the chief engineer's office will know the company's own plant. Hence, it will not have to try in vain to match up maps that disagree, and guess at the topography, and in the end send a survey party out whenever a small change or addition is contemplated. A feature of the making of the surveys is the housing of the company's men, as well as those of the Government, in cars fitted for the purpose.



MAP OF DELAWARE AND HUDSON CO.'S SYSTEM

Independent Surveys

The independent surveys are being made on those parts of the line carrying the heaviest traffic and on which, owing to the age of the property, the records are the least complete. The purpose is to escape the demands for speed made upon the Government parties and give the company forces all the time needed to trace out the items of property. Consequently, no speed records have been made or tried for, and progress has been what many would call slow, especially where it has been necessary to run the land lines.

The work done in the independent surveys varies according to conditions, it being necessary in some cases to make a complete resurvey, including right-of-way, and in others to rerun alignment. In all cases, however, each party makes a complete cross-section survey and also a chain survey to locate all tracks, buildings and other structures.

Personnel of Party

For these independent surveys the field parties have ranged from six to sixteen men, depending on the classes of work done. The sixteen-man party was made up as follows: Chief of party, three instrumentmen, a recorder, draftsman, six rodmen, three chainmen and a ballast man. Roughly speaking, there were the following squads: Chaining, alignment, right-of-way, cross-section and bridge-and-building.

Incidentally, for the protection of the men, this large squad having been employed in the Scranton-Wilkes-Barre section, where the traffic is heavy, a bridge carpenter was kept with the party as a watchman to warn of approaching trains. He also helped take building notes, and his use is believed to have been fully justified.

With the full-size party on this work the chaining squad proceeds in advance, using a steel tape and making temperature corrections. The chaining squad is followed by the alignment party, when that work is necessary, and later by a cross-section squad, which also carries through a continuous line of levels for the purpose of preparing a profile.

Form Y-1

VALUATION DEPARTMENT
THE DELAWARE AND HUDSON CO.
DAILY REPORT OF FIELD PARTY

VALUATION SECTION No. _____ DATE _____ 19__
OPERATING DIVISION _____ FIELD HEADQUARTERS _____
WEATHER _____

	FROM STATION	FROM PLUS	TO STATION	TO PLUS	DISTANCE IN FEET
ALIGNMENT					
MAIN LINE					
" "					
BRANCH					
"					
CHAINING					
MAIN LINE					
" "					
BRANCH					
"					
"					
CROSS SECTIONS					
MAIN LINE — SECTIONS TAKEN					
" " " "					
" " " PLOTTED					
" " BRANCH " TAKEN					
" " " " "					
" " " PLOTTED					
" " " " "					
INVENTORY					
MAIN LINE					
" "					
BRANCH					

REMARKS

TELEGRAPHIC ADDRESS _____ CHIEF OF PARTY _____

Form Y-2

BOOK NO. _____ VALUATION DEPARTMENT PAGE NO. _____
THE DELAWARE AND HUDSON CO.
BUILDINGS
ACCOUNT NO. _____ MILE _____

VALUATION SECTION No. _____ DATE _____ COMPILED BY _____
OPERATING DIVISION _____ CHECKED BY _____

STATE _____ COUNTY _____ TOWN _____
LOCATION _____ USE _____ STA. _____ PLUS _____
BUILT BY _____ YEAR BUILT _____ DRAWING No. _____
HEIGHT MAIN _____ PLATFORM—MATERIAL _____ AREA—MAIN _____ SQ. FT.
" ADDITION _____ " SIZE _____ " ADDITIONS _____ "
SIZE MAIN _____ " " _____ " TOTAL _____ "
" ADDITION _____ " AREA _____
" BASEMENT _____
DEPTH " _____ CONTENT—MAIN _____ CU. FT.
SHED—SIZE _____ COST—ACTUAL _____ " ADDITIONS _____ "
" HEIGHT _____ " ESTIMATED _____ " BASEMENT _____ "
" " TOTAL _____ "

REMARKS

UNITS	DESCRIPTION	QUANTITIES
GRADING—GROUNDS		
EXCAVATION—FOUNDATION		
FOUNDATION		
FLOORS		
"		
WALLS—EXTERIOR		
" "		
" INTERIOR		
" "		
FRAMING		
"		
ROOF		
EAVES		
EXTERIOR FINISH		
"		
INTERIOR "		
" "		
WINDOWS		
"		
DOORS		
STAIRS		
PLATFORM		
TINNING		
PLUMBING		
LIGHTING		
HEATING		
SEWERS		
PAVING		
SIDEWALKS		
STATION SIGNS		

BOOK NO. _____ VALUATION DEPARTMENT PAGE NO. _____
THE DELAWARE AND HUDSON CO.
CULVERTS
ACCOUNT NO. _____ MILE _____

VALUATION SECTION No. _____ DATE _____ COMPILED BY _____
OPERATING DIVISION _____ CHECKED BY _____

STATE _____ COUNTY _____ TOWN _____
TYPE OF STRUCTURE _____ DRAWING No. _____
NEW NUMBER _____ OLD NUMBER _____ LOCAL NAME _____
LOCATION _____ MILES NORTH OF SOUTH OF _____ STATION _____ PLUS _____
PURPOSE _____ NUMBER OF TRACKS _____ OVER _____
BUILT BY _____ ERECTED BY _____ YEAR _____

MASONRY AND WOODEN		PIPE		EXCAVATION	
SIZE	LENGTH	KIND		EARTH—DRY	CU. YDS.
MATERIAL		SIZE		" WET	"
BENCH WALLS		LENGTH		ROCK—LOOSE	"
TOP		WEIGHT		" SOLID	"
END WALLS					
WING WALLS					
FOUNDATION					
PAVING					

MISCELLANEOUS			
	KIND	CLASS	QUANTITY

QUANTITIES

MASONRY ABOVE FOUNDATION			CULVERT IN FOUNDATION			WOODEN CULVERT	
KIND	CLASS	QUANTITY	KIND	CLASS	QUANTITY		
		CU. YDS.			CU. YDS.	BOLTS	LBS.
		"			"	BOAT SPIKES	"
		"			"	TIMBER	F. B. M.

Form Y-3

BOOK NO. _____ VALUATION DEPARTMENT PAGE NO. _____
THE DELAWARE AND HUDSON CO.
BRIDGES, TRESTLES & OPEN CULVERTS MILE 131
ACCOUNT NO. 6

VALUATION SECTION No. 14A DATE June 29, 1916 COMPILED BY C.W. Leinbach
OPERATING DIVISION Champlain CHECKED BY _____

STATE New York COUNTY Essex TOWN Westport
TYPE OF STRUCTURE Riveted Pratt Truss - Latticed DRAWING No. 548-23592
NEW NUMBER 130.68 OLD NUMBER 34 LOCAL NAME _____
LOCATION 0.08 MILES SOUTH OF Wadhams STATION 2709 PLUS 82
PURPOSE Waterway NUMBER OF TRACKS 1 OVER Bouquet River
BUILT BY American Bridge Co. ERECTED BY J.B. Chacy YEAR 1913
LIVE LOAD AND SPECIFICATIONS USED IN DESIGN E60 - The D&H Co. Specifications with modifications - Specifications of 1904
EQUIV'T LIVE LOAD A. R. E. A. SPECIFICATIONS, COOPER LOADING E60 with Impact.

SUPERSTRUCTURE

UNITS	TRUSSES	SPAN	PANELS	FLOOR BEAMS	STRING-ERS	BENTS
MATERIAL	Steel			Steel	Steel	
CT. TO CT.	174'0"	165'8"				
NUMBER	2	1	8	9	16	
LENGTH	153'6"	147'8"	18'-6"	13'6"		
WIDTH				12'6"	12'6"	
DEPTH	20"	28'0"		64"	24"	

DECKING

UNITS	KIND	NO.	SIZE	QUANTITY
TIES	Y. Pine	132	8"x8"x8'-6"	
GUARD RAILS	"	2	6"x8"x153'6"	
FLOOR	Laps	72	3"x10"	
HOOK BOLTS				
WASHERS		72	6"x3½"	
PLANK	✓			
PAVING	✓			

EXTREME LENGTH 155'-6"
ANGLE WITH CENTER LINE 90°
BASE OF RAIL TO BRIDGE SEAT 64 3/4"
" " " BOTTOM 10'-4"
CLEARANCE TO HIGH WATER _____
" " LOW " _____
" OF OVERHEAD _____
TELL TALES 1602
SIGNS 0
FIRE PROTECTION 0

QUANTITIES

EXCAVATION—FOUNDATIONS		
EARTH—DRY		
" WET		
ROCK—LOOSE	✓	
" SOLID	✓	

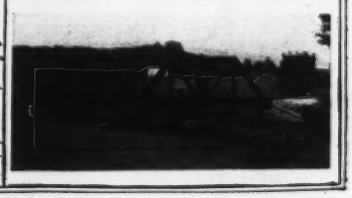
FOUNDATIONS		
KIND	CLASS	QUANTITY

SUBSTRUCTURE

MASONRY, PIERS & ABUT'S		
KIND	CLASS	QUANTITY
Conc.	C.	C. YDS.
		"
		"

MISCELLANEOUS		
KIND	CLASS	QUANTITY

STEEL SUPERST'R (CALCULATED) _____ LBS.
" " (SHIPPED) 377,802 "
" RE-INFORCING BARS _____ "
" GUARD RAILS _____ "
ANGLE BARS _____ PRS.
TRACK BOLTS _____ KEGS
" SPIKES _____ "
BOLTS _____ LBS.
LAG SCREWS _____ "
BOAT SPIKES _____ "
WASHERS _____ "
TIMBER _____ F. B. M.
RAILS _____ LBS.
PILES _____ LIN. FT.



FOUR SELF-DEFINING FIELD FORMS—FEATURE OF ONE FILLED OUT IS PHOTOGRAPH OF STRUCTURE

The chaining and alignment parties are later combined, and they make a full chain survey of all tracks, buildings and other physical features, so that all necessary information is obtained for the preparation of complete maps of the territory covered. Notes, sketches and photographs are made of all buildings, bridges, culverts and other structures, to the end that a complete record of the physical features of the road is collected. A sample page of the notes for a bridge is reproduced. The maximum monthly payroll of the sixteen-man party was $1215, with living expenses paid occasionally when the men were away from headquarters overnight.

Joint Surveys

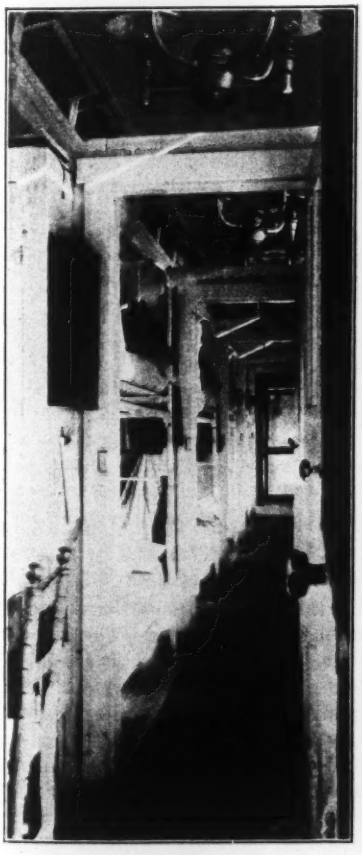
During 1916 the Division of Valuation assigned one party to The Delaware and Hudson Co. The company desired more information than the Government required, and in order to make the progress demanded by the authorities at Washington it added a party of fourteen men (this has in some cases been increased to sixteen) to the Government's squad of nine. The combined parties obtain virtually all the data being obtained by the company's independent surveys, in addition to that specifically required by the Government. The only inventory work not done, for which further trips over the line will be necessary, is for signals and interlocking, for telegraph and telephone lines and for checking the notes of buildings and the larger bridges, the Government not having special men available for these classes of work.

This joint arrangement has worked so harmoniously that the Government and company squads have not merely worked over the same territory, each getting the data it wanted, but have subdivided the work and exchanged men to the best advantage. The Government has made certain stipulations, one being that there must be two cross-section parties, on the theory that the continuous-profile method takes twice as long as the hand-level method with subgrade as datum. There are also usually four men computing, to keep the figures close up to the field notes.

Somewhat Different Personnel

The make-up of the company's party for the joint surveys is somewhat different from that of the party on the independent surveys and is about as follows: Chief of party, two recorders, a computer, transitman, draftsman, leveler, four rodmen and five chainmen. The monthly payroll for this party has averaged about $1080, with full subsistence at all times.

Undoubtedly, the friendly coöperation that has prevailed in the joint surveys has been due to the confidence the Government has been able to repose in the company's men. It has been impressed upon the latter that they are to claim only what is fair, and the Government men apparently realize that fact. It is also understood that each difference of opinion shall be fought out on its merits—that there shall be no bargaining to confound the records at some future date and make an interpretation of them difficult.



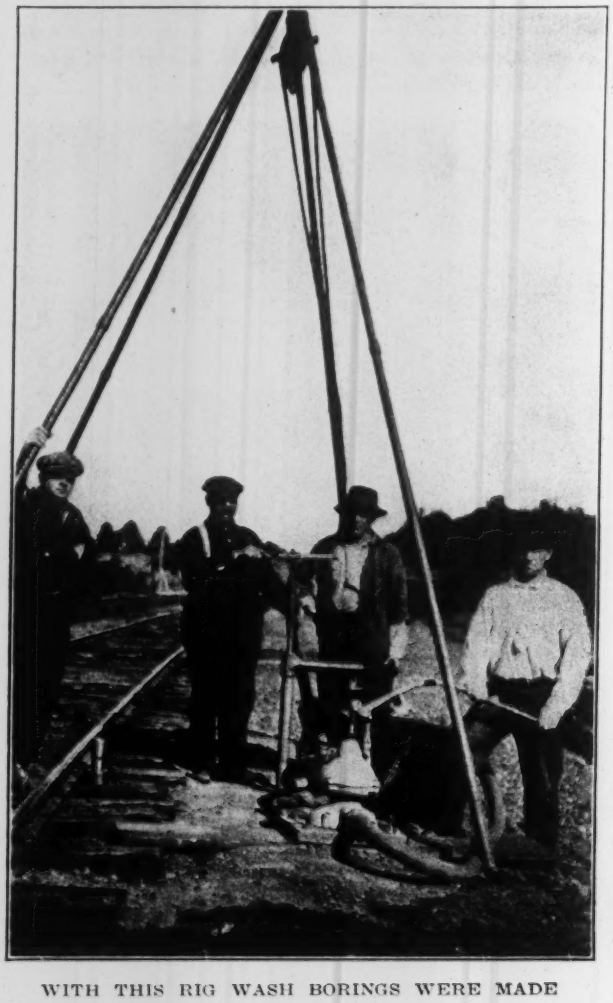
INTERIORS OF THE THREE COMPANY CARS OF THE CAMP TRAIN FOR THE JOINT SURVEYS

For the field notes the ordinary-sized notebooks were found unsuitable, and sheets 8½ x 11 in. (Delaware & Hudson correspondence size), ruled as necessary, are used. They have been found very satisfactory. Various forms, some of which are reproduced, were prepared. These are in addition to the duplicate note forms used by the Government, some of which were shown in *Engineering Record* of July 22, 1916, p. 105.

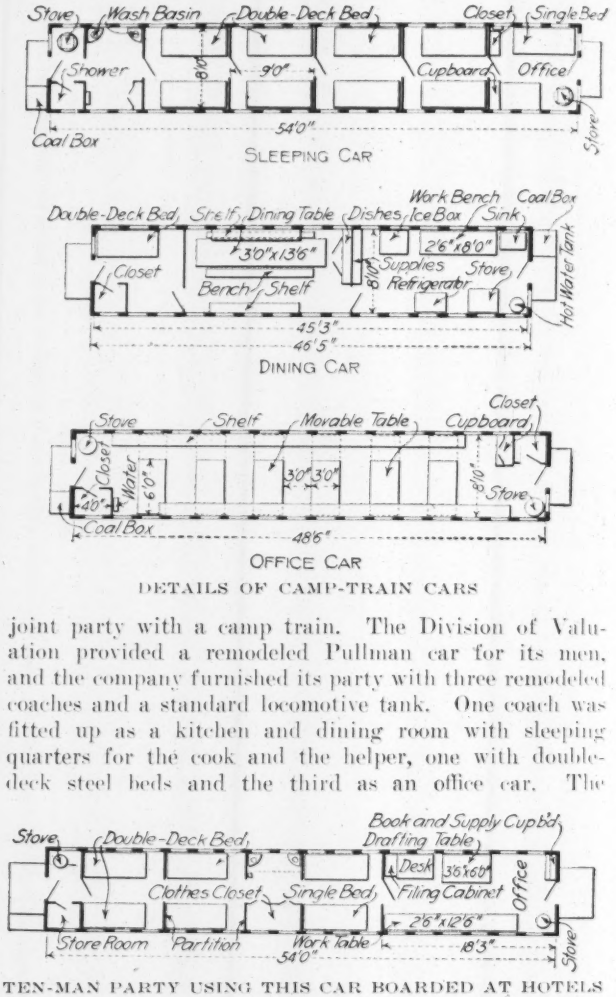
In many cases, especially for the older bridges, culverts and buildings, no office records could be found, and complete detail sketches were made. The field parties are furnished with all plans on file in the general office. In many cases this includes original construction profiles and cross-sections, and these have proved of great value. Before the field work started, a complete list of all record plans was made in the chief engineer's office; and a description more complete than that of the card index was entered after examination of the plans. More than 20,000 plans were listed, and it took two men nearly four months; but the expense has been fully justified.

Subsistence for Parties

Inasmuch as parts of the road pass through country sparsely settled, where it would have been impossible for so large a party to find suitable living quarters, without great loss of time, it was found necessary to equip the joint party with a camp train. The Division of Valuation provided a remodeled Pullman car for its men, and the company furnished its party with three remodeled coaches and a standard locomotive tank. One coach was fitted up as a kitchen and dining room with sleeping quarters for the cook and the helper, one with double-deck steel beds and the third as an office car. The dining-car department of the company has had charge of the commissary arrangements and has produced very satisfactory results at slightly less than $1 per day per man, this including wages of cook and helper.



WITH THIS RIG WASH BORINGS WERE MADE



DETAILS OF CAMP-TRAIN CARS

TEN-MAN PARTY USING THIS CAR BOARDED AT HOTELS

On one of the other divisions, where hotel accommodations were not entirely satisfactory, but where the towns averaged four miles apart, one coach was provided with sleeping accommodations for ten men and space at one end for an office. Meals were obtained on a satisfactory basis at the local hotels. The use of these cars resulted in a considerable reduction in the cost of subsistence and at the same time provided comfortable permanent quarters for the men.

Wash Borings To Test Subsidence

Like many other roads, this one has its sections—along the shores of Lake Champlain, for example—where there has been much subsidence. The records show much of this, but are incomplete. Wash borings have been resorted to, and the company has profited more or less by the experiences of other roads that faced the problem sooner. Bids were asked for, but they contained so many conditions that the company decided to do the work by company forces.

Two simple outfits like that shown were made in the company's shops. In addition, two Sheffield hand-cars

and four standard track jacks were bought, and a 6 x 20-ft. scowboat was built for use where the fill crosses bays of Lake Champlain.

Cost of Borings

The working force consisted of one foreman at $2.85 per day, five men at $2.75 and a recorder at $50 per month. The foreman and his men were also allowed $1 each per day, and they lived in a maintenance-of-way boarding car, cooking their own meals. They were company bridge carpenters. The recorder was a rodman from the survey party, and his expenses were about $2.25 per day. The cost of the boring outfits was as follows:

2 double A-frame drilling outfits	$299 22
4 standard track jacks	43 36
2 Sheffield hand-cars	63 00
1 boat	101 30
Total	$506 88

In a report by Mr. Mansfield, the company's valuation engineer, it is pointed out that the outfits can be used to great advantage by the maintenance-of-way department when the valuation department is through with them.

By the use of the outfits over an aggregate of about 12 miles, 1,870,883 cu.yd. of filling material and 45,603 cu.yd. of riprap were discovered. This work was done at a total cost of $1570 exclusive of plant investment, or at a cost of 31.82c. per lin.ft. inclusive, or 25.56c. exclusive, of the recorder. The total cost per yard of all material disclosed was less than 0.1c. per cubic yard.

Program of Work

As previously mentioned, it has been the aim of the company to precede the Government with independent surveys over the parts of the system involving the greatest difficulties. One of these (referring to the map of the system) is the section from Wilkes-Barre to Carbondale, where the traffic is very dense. Another is the main line north from Albany, which carries heavy traffic, and part of which was built as early as 1835.

In August, 1915, two survey parties were started, at Wilkes-Barre and Binghamton respectively. In May, 1916, on the arrival of the Government forces, a new party was organized and put on joint work with the Government on the Champlain division. The joint party, before the end of last year, covered the entire Champlain division, the line between Whitehall and Rutland and that between Eagle Bridge and Castleton—a total of 345 miles. Work by the joint party was discontinued Dec. 15, 1916, because of heavy snow. Meanwhile, the Wilkes-Barre party had joined up with the work done by the Binghamton squad, which latter had completed its work to Albany. Independent surveys made to Jan. 1, 1917, aggregated 267 miles of line.

The Government is now checking up the surveys and taking the track inventory on the southern end of the road, covered by the independent surveys. Each chief will be with the Government party on the part of the line he has surveyed, while an independent survey will be made north from Albany. By the time the Government overtakes the independent survey, it is expected that the main line from Albany to Whitehall will have been completed. Joint surveys will then finish the road. The completion of the program involves 85 miles of independent and 128 miles of joint survey.

The work is being carried on under the supervision of the writer. W. H. Mansfield is valuation engineer.

Small Clearance Under Steel Bridge Calls for Shallow Floor

Curved Girders Used in One of Side Spans of Cambria Street Structure in Philadelphia — Steelwork Incased in Concrete

By JONATHAN JONES

Assistant Engineer (Bridges) Bureau of Surveys, Department of Public Works, Philadelphia

REMARKABLY shallow floor and horizontally curved plate girders are prominent structural features of a new street bridge in Philadelphia. They were dictated by difficulties of location and of adjustment to street and railway grades. Æsthetic problems also had an influence in the design; the effect may be judged from Fig. 1.

The bridge carries the traffic of Cambria and A Sts. across the depressed Richmond branch of the Philadelphia & Reading Ry. The street system is diagonal to the railway. As the railway is much older than the streets, the latter have only few crossings over the railway cut. The new bridge, therefore, had to be designed with regard to carrying the traffic of a number of streets. At the same time the approach gradients had to be kept down to a minimum.

Cost of Skew Crossing Prohibitive

A skew crossing on the line of Cambria St. was first outlined. However, the railway company then asked for a single central span over the present six tracks and side spans to provide for respectively three and four future tracks. With such spans a skew crossing would have been of prohibitive cost and its roadway gradients excessive. In the final design, therefore, the bridge crosses the railway cut at right angles. This arrangement has the further advantage of making it easy to provide approaches from two streets at each end. The side spans curve out (increasing in width toward the abutments), to accommodate the approach roadways. At these curves the extra-shallow east span required horizontally curved plate girders.

The approach gradients do not exceed 4% and the grade changes involved extend back only about 150 ft. The minimum clearance thus obtained is 16 ft. over top of rail. This headroom is the best obtainable at several other bridges on this line of railroad, as the streets have built up so densely, adjacent to the tracks, that the cost of raising the approaches is prohibitive. The Public Service Commission of Pennsylvania is seeking to maintain a standard headroom of 22 ft., and in this instance approved the lower headroom only on condition that the masonry should be carried down to such an elevation that the tracks could in the future be lowered 6 ft. without exposing the foundations. This requirement was expensive, as the material taken out below track level was all hard rock.

The cartway width adopted is 36 ft., which provides for four lines of travel, including possibly a double-track electric railway in the future. The sidewalks are 8 ft. each, a total width of 52 ft. being all that it was deemed practicable to span with the very shallow floor-beams (2 ft. 4 in. deep over covers) necessitated by adhering to a 4% maximum grade.

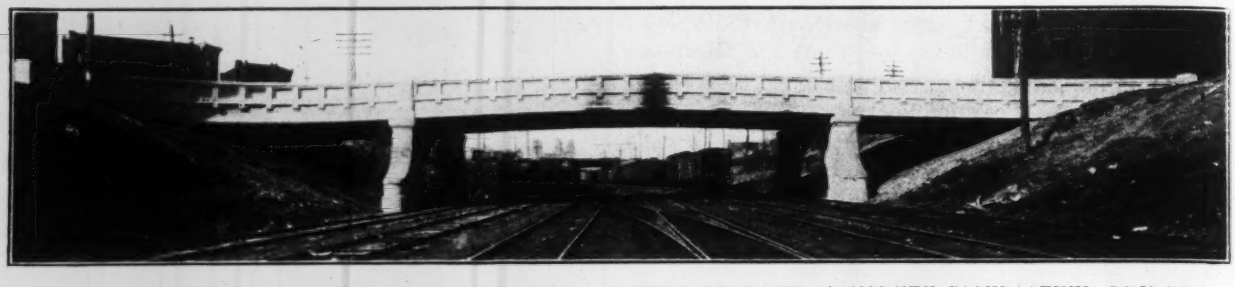


FIG. 1. THE CAMBRIA ST. BRIDGE, PHILADELPHIA, A WELL-DESIGNED CONCRETE-CASED STEEL BRIDGE WITH VERY SHALLOW FLOOR

The superstructure throughout is of structural steel, unpainted, fully incased in concrete as a precaution against corrosion, which is very rapid over and adjacent to steam railways where the headroom is so limited. The steel weighs about 75 lb. per sq.ft.

Girder Span with Shallow Solid-Floor

The main span, crossing six tracks, comprises two girders 80 ft. 7½ in. c. to c. bearings, forming the parapets, loaded by transverse floorbeams, 4 ft. 11 in. apart. The roadway floor is of asphalt, on transverse concrete arches sprung between and surrounding the floorbeams. The sidewalk is granolithic, on reinforced-concrete slabs and cinder filling. The top flanges of the steel floorbeams are held low enough to take a future 9-in. electric-railway rail, with 2 in. of concrete covering the beams. The concrete arch floor is pushed up to the under side of the 3-in. asphalt paving of the crowned roadway, thus taking advantage of the increase in total depth of the concrete floor.

In computing the maximum stress on the steelwork it was assumed that the steel floorbeams alone must carry the entire weight of the wet concrete, but that for live-load the floorbeams are compound beams, the considerable amount of concrete over their tops adding to the composite moment of inertia and reducing the stress in the steel from 18,000 (if the effect of the concrete were neglected) to the desired 16,000 lb. per sq.in.

FIG. 2. VIEW UNDER FLOOR, SHOWING TWO-PEDESTAL PIER AND INCASEMENT OF SIDE-SPAN STRINGERS

To permit cutting the concrete to install the future rails without destroying the value of the arch construction, a concrete strut was cast into the floor under the position of each possible future rail, for either single track or double track. These struts serve also as a sort of "bridging" to make several floorbeams deflect in unison, and they therefore distribute concentrated live-loads to a considerable degree. This consideration, however, was not availed of to reduce the amount of steel. The floorbeams were cambered to allow for their dead-load deflection; and before the pouring of the floor concrete, levels were run over the beams at both curb lines and the center of the bridge, and the finishing heights for the concrete were established to allow for deflection.

Steelwork Incased in Concrete

The depth of the 80-ft. 7½-in. main girders was determined by adding to the available floor thickness the depth to give a 3-ft. 10-in. railing height, making about 7 ft. These girders weigh about 40 tons each and are entirely incased in 1 : 1½ : 3 concrete anchored to the webs by clamps of ¼-in. square steel, spaced about 12 in. on centers. These girders do not need pin bearings, as the live-load deflections will be quite small; but the girder deflection during the placing of the dead-load was allowed for by giving them bearings on steel billets with curved upper surface, the ornamental posts that incase these billets being poured after the other dead-load was so far as possible in place.

The 43-ft. 7¼-in. span toward Gurney St. consists mostly of longitudinal 28-in. I-beams, 4 ft. 11 in. on centers, with concrete arch construction as noted above for the roadway and similarly designed to take advantage, for live-load, of the compressive value of the concrete. The quadrant curves in the parapet are carried by a 23-in. built-channel fascia, supported at intervals by an angular framing of straight beams, some of which are cantilevered from the main beams adjacent and one of which is cantilevered from the abutment and anchored thereto with rods 10 ft. long. In this latter case the nuts were tightened after the steel was all lined up, and care was taken to throw the bearing of this beam back of the edge to avoid spalling of the concrete.

Curved Girders Used in One Span

The span toward Tusculum St. is structurally the most interesting part of the design, because the curved parapets are formed by incased steel girders. The square length of the span is 56 ft. 4½ in. from center line of pier to center line of bearing on abutment, and the interior longitudinal floorbeams on this span are only 22 in. deep because of the limited thickness of the floor.

The curved parapet girders are about 7 ft. deep, corresponding to those of the six-track span, and have stiffeners spaced uniformly about 4 ft. 8 in. apart, conforming to the spacing of the ribs that show on the finished concrete. At every second or third stiffener, as required, there is attached a bracket that transfers the tipping moment (created by the fact that the girder is at such point offset from the straight line joining its supports) from the girder to the adjacent straight beam. These brackets have the general nature and shape of bell cranks; to provide for the moment in the vertical legs just above the sidewalk where their width is limited in order not to project beyond the stiffener incasement, the flanges require considerable reinforcement. The outer, or tension, flange is reinforced with flats between the stiffener legs, and the inner or compression flange with continuous angles that bend around under the sidewalk to form the top flanges of the horizontal legs of the bell cranks.

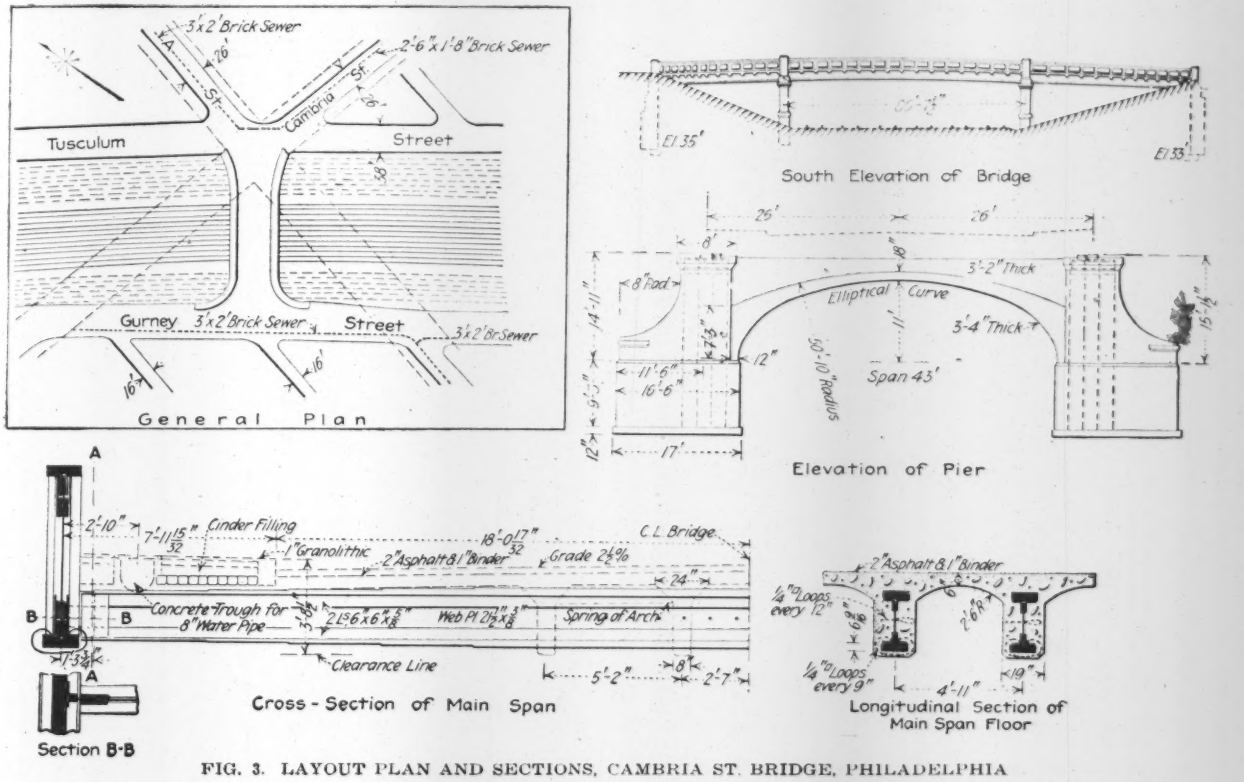


FIG. 3. LAYOUT PLAN AND SECTIONS, CAMBRIA ST. BRIDGE, PHILADELPHIA

The effect of this design is to throw most of the vertical load over to the interior floorbeams, and the curved girders are light. Their fabrication was quite unusual in that they combined the horizontal curvature with a considerable vertical grade, corresponding to that of the approach. The shopwork was very creditable, the work fitting up to plan measurements better than in the case of much straight steelwork, requiring very little allowance in the forms to obtain smooth and accurate lines in the finished concrete.

The steel details and the floor were considerably complicated by the necessity for carrying two water pipes and several lines of ducts across the deck of the bridge. The floor is so thin that it required ingenuity to install the water pipes, as the best practice requires gullets with removable slab covers to make them accessible for inspection and repair. In fact, it was not possible to make these gullets deep enough for calking the joints, and they had to be poured with "leadite." Drainage holes through the slab were provided as a precaution against damage from leaks.

Architectural and Street Problems

The architectural details of this bridge are not elaborate nor worked to fine dimensions, but are rather bold to conform to the necessarily heavy sections of material used. On the inside the parapets have practically all the edges chamfered off, the design being made to conform with the chamfering. In many neighborhoods the edges of concrete railings and ornamentation are apt to receive rough treatment, particularly from the thoughtlessness of boys; and as such treatment was anticipated in this particular location, it was thought best to provide a design that would have a good chance of retaining its original form without disfigurement. All the showing faces of the substructure were given a granolithic face mixed 1 : 1½ : 3; and the parapet girders were poured of this same mixture, as the nature of the forms would not permit of a facing mixture on a less expensive backing. All the faces that are exposed at the present time are bush-hammered by hand, the edges being lightly chiseled where necessary to preserve them from breaking under the heavy hammer.

The plan of repaving was complicated by the irregular lines and variable grades of the approaches. Most of the streets, for instance, are lower on one curb than on the other, while the bridge itself was designed 0.2 ft. lower on one side than on the other, to take advantage of the corresponding grade of the railroad. The repaving was therefore studied out in its entirety on contour plans

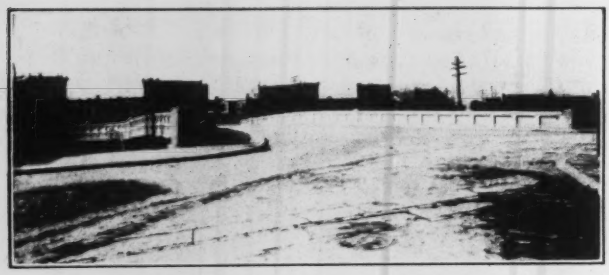


FIG. 4. LOOKING ALONG CAMBRIA ST., SHOWING GRADED APPROACH TO BRIDGE

to a scale of ⅛ in. to the foot, showing contours 0.1 ft. apart, these being so drawn in as to give proper grades for the several lines of traffic, minimizing the future changes necessary to give superelevation to the possible electric railway. From these contours the necessary inlets were designed to receive the surface water, and, by making the proper allowance for gutter depths, the curb heights.

Payment for the bridge from back wall to back wall was by lump sum, while the work on the approaches was in accordance with unit prices. The following schedule of unit prices for the bridge proper, covered by the lump sum of $46,335, is therefore only an approximation for current estimates, and the unit prices indicated therein may differ somewhat from those shown in the estimate sheet of the successful bidder, only the total lump sum being a matter of contract. The total cost, including the revision of approaches, but no damages, was $56,369. The date of letting was Aug. 2, 1915; the bridge proper was completed in July, 1916.

	Quantity	Unit Price	Amount
Sign posts	2	$29.00	$58
Foundation concrete, including excavation	473 cu.yd.	8.00	3,784
Neat concrete, including rods, etc.	1000 cu.yd.	6.00	6,000
Structural steel	392 tons	69.00	27,048
Concrete in floor	532 cu.yd.	7.00	3,724
Concrete in railings and parapets	170 cu.yd.	10.00	1,700
Granolithic steel-bound curb	500 lin.ft.	.80	400
Granolithic sidewalk	388 sq.yd.	1.25	485
Asphalt paving	848 sq.yd.	1.60	1,356
Ducts (single cell)	2,000 lin.ft.	.10	200
8-in. water pipe	370 lin.ft.	2.00	740
Inscription tablets	2	20.00	40
Inspection			800
Total			$46,335

The design was prepared and the construction supervised by the writer, originally under George S. Webster, Chief Engineer, and M. L. Cooke, Director of the Department of Public Works; later under Chester E. Albright, Chief Engineer, and George E. Datesman, Director. The contractor was James D. Dorney.

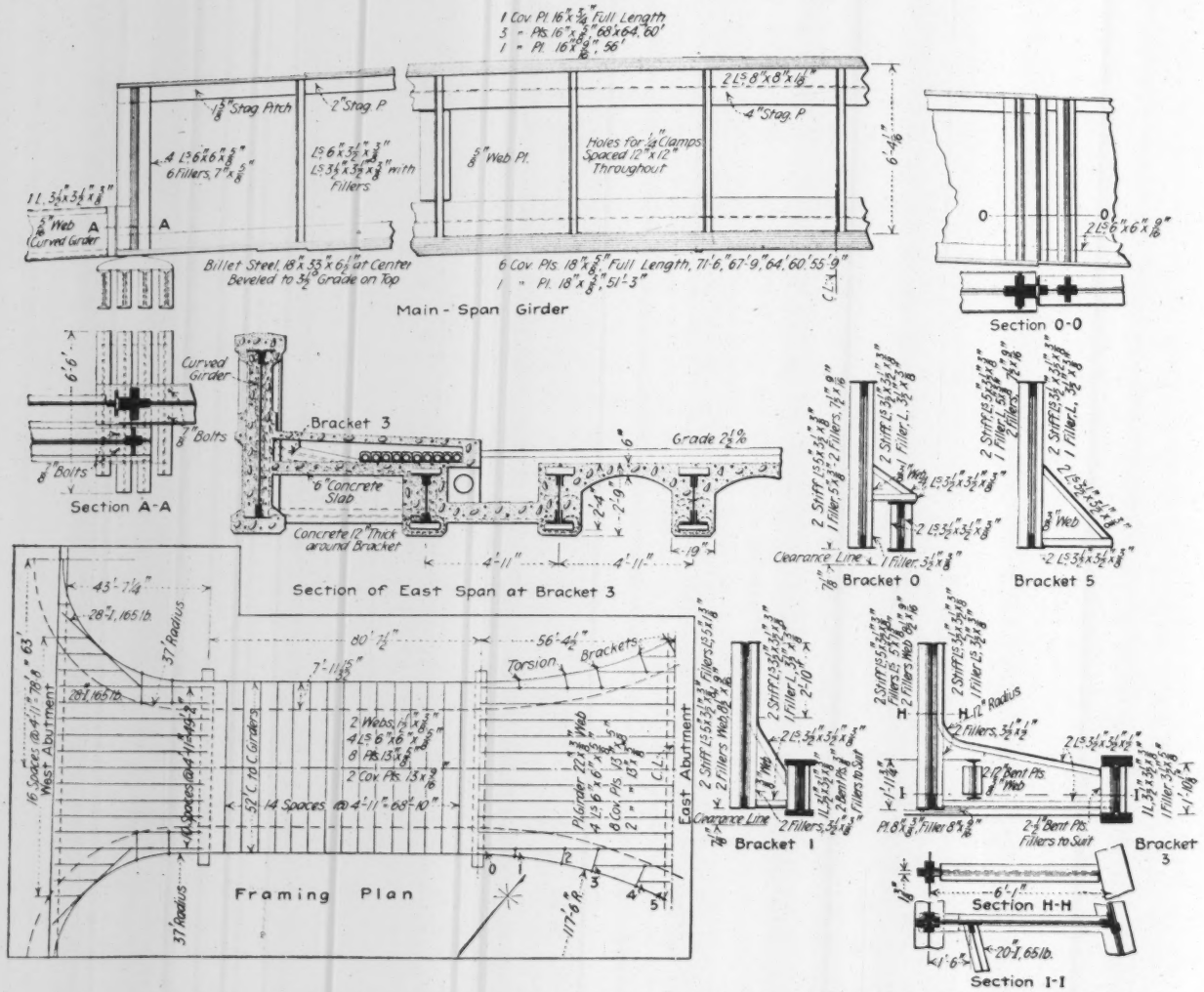


FIG. 5. SHALLOW FLOOR FRAMING, AND CURVED GIRDER IN EAST APPROACH, CAMBRIA ST. BRIDGE

New Intercepting Sewer at Chicago Stockyards Has Brick Arch Anchored to Concrete Base

Underground Viaduct Carries Sewer Through a Bed of Soft Soil—In Building Brick Arch Traveling Steel Centers Were Used

By L. B. BARKER
Assistant Engineer, The Sanitary District of Chicago

SYNOPSIS—This article describes several details in the construction of a sewer having a brick horseshoe arch on a concrete slab base. Of special interest is a concrete-arch foundation or underground viaduct to carry the sewer through a bed of soft soil. An unusual feature is the use of traveling steel centers for the brick arch.

INTERESTING items of design and construction are included in the new stockyards intercepting sewer at Chicago. It is built along the south bank of Bubbly Creek and replaces that notorious section of Chicago's sewerage system, as described in *Engineering News*, Sept. 14 and Oct. 19, 1916. The new branch intercepts the 6-ft. Ashland Ave. sewer and 9-ft. Robey St. sewer and connects with the mouth of the West 39th St. conduit leading to the drainage canal. Its purpose is to stop the discharge of sewage into the Chicago River at Ashland Ave.

The new sewer is about 3450 ft. long, of semi-elliptical section, having a brick arch anchored to a reinforced-concrete base by dowel rods. To guard against possible deterioration of the concrete due to the excessively strong packing-house sewage, the concrete invert is lined with vitrified tile. These tiles are 12x24 in., 1 in. thick, molded to the curve of the invert and scarified on the under side. The section is 7 ft. high and 7 ft. wide, except for 770 ft. at the west end, where it is 9x9 ft. The details are shown in the drawings.

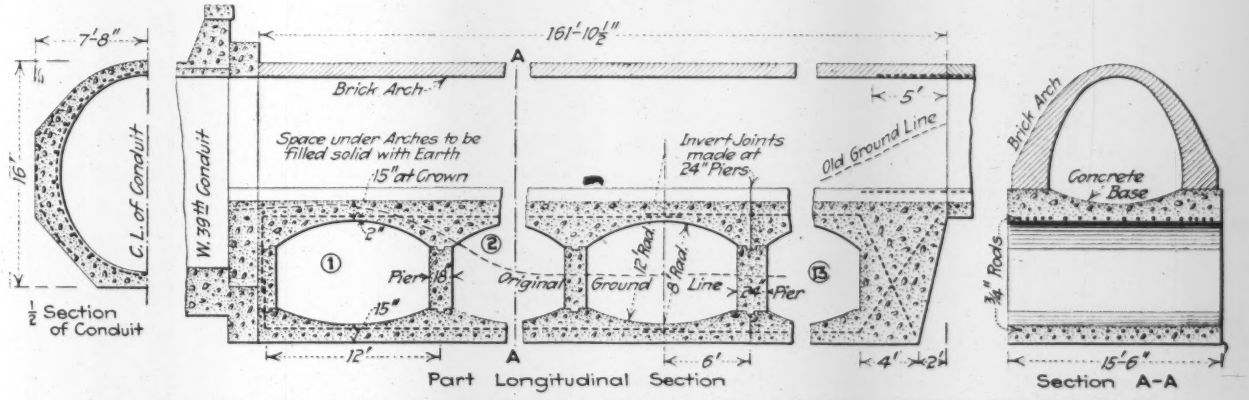


FIG. 1. SEWER BUILT THROUGH SOFT MUCK, SUPPORTED BY CONCRETE ARCHES FOUNDED ON A SOLID SUBSTRATUM

Concrete Foundation and Chambers

At the west end the sewer (9x9 ft.) makes a 90° turn and extends for about 150 ft. across Bubbly Creek (now being filled up) to the mouth of the West 39th St. conduit (12x14 ft.). The water here was about 8 ft. deep, with 4 to 10 ft. of soft black muck formed by the sewage deposit of many years. Under the muck is a hard dry boulder clay.

The muck bed could not support the weight of the sewer, and therefore a deep foundation like an underground viaduct is built on the firm clay bottom to carry the sewer at proper elevation across the bed of the creek, through the muck. This unusual substructure consists of a concrete slab 15 ft. 6 in. wide, with piers 12 ft. c. to c. carrying a series of arches that are formed integrally with the base of the sewer. The space beneath the arches is filled solid with clean earth. The height from the bottom of the foundation slab to the sewer invert is about 10 ft. Fig. 1 shows this interesting construction, the part above the crown of the arches representing the typical construction of the remainder of the sewer, with the brick arch on a concrete base and invert.

The sewer connections are made in flat-roofed chambers of reinforced-concrete, the one at Robey St. having intake and discharge compartments for the possible future installation of flushing pumps. The change in size of sewer is made at this point. At Ashland Ave. there is an overflow chamber, on pile foundations. It is separated from the sewer chamber by stop planks, so that excessive flow may be relieved by discharge into the river.

Excavation for Sewer

The excavation along the bank of Bubbly Creek was done with a Thew revolving shovel having a 1-yd. bucket. For the greater part of the way the cut was made in two lifts, the first being 30 ft. wide by 7 to 10 ft. deep; the second was 8 ft. deep, 11½ ft. wide for the 7-ft. and 14½ ft. wide for the 9-ft. section. The same section was maintained when the cut was made in a single lift, the extra width at the top being necessary to allow the shovel to

turn. Sheeting was used only in the bottom cut, except where necessary to repair adjacent structures.

The shovel was supported on timber floats. Five floats were used, the rear one being picked up by the dipper and placed ahead as the shovel rolled onto the foremost one. However, in the deep cut, it was impossible for the shovel to dump onto the spoil bank from the bottom of the trench. To remedy this, cribs of 12x14-in. timbers, 6 ft. high, bolted together, with the floats bolted to their tops, were used. They were carried ahead in the same manner as the floats. Fig. 2 shows the steam shovel standing on the cribs.

The excavating gang consisted of the shovel engineman and fireman, two bottom men with the shovel (trimming the trench ahead of the cribs, securing the cribs in place and tending the shovel), two to four bottom men behind the shovel (trimming the trench to line and grade and placing the sheeting) and occasionally two to five laborers shoveling out hand-excavated material, by means of platforms, when the cut happened to be exceptionally heavy.

Material, Stiff Blue Clay

Good, stiff blue clay, overlain with 4 to 6 ft. of cinders and manure, was encountered for about 75% of the distance. For about 800 ft. the trench seemed to lie on the edge of what was the original bed of the creek and in an old cinder fill, except for a distance of about 100 ft. This fill did not extend to the bottom of the cut, so that a good clay foundation was found; but a great deal of trouble was caused by the water that poured through the loose cinders between the trench and the creek only 20 ft. away. Sheeting was driven as fast as the excavation was made and clay puddled behind it.

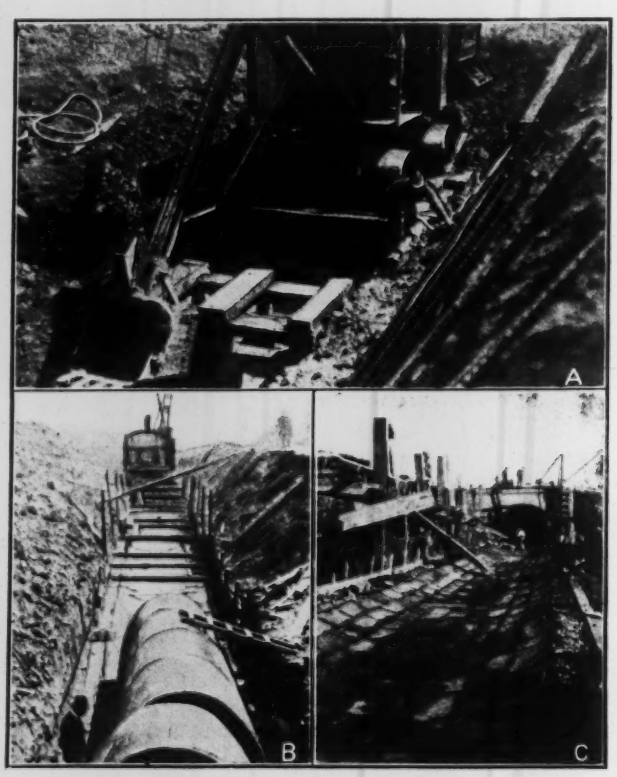


FIG. 2. BUILDING THE STOCKYARDS SEWER AT CHICAGO

A—Steam shovel standing on cribs to take out second lift of deep cut. B—Steel centering for brick arch; note the tows of dowel rods to bond this arch to the concrete base. C—Tile-lined invert of sewer. This shows the end of the work built across Bubbly Creek to connect with the West 39th St. conduit

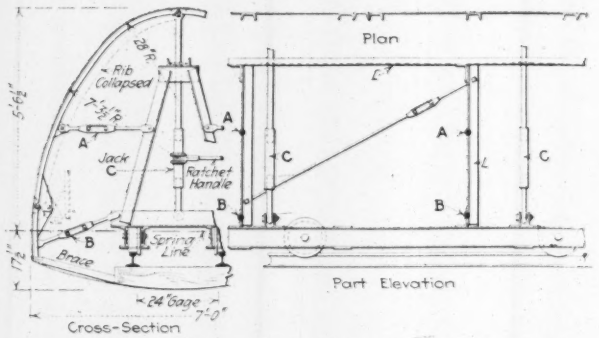


FIG. 3. COLLAPSIBLE STEEL CENTERING USED FOR BRICK ARCH OF SEWER

In general, the excavated material was dumped along the north bank of the trench and allowed to spill over into the river, no attempt being made to save it for backfill. Only sufficient backfill to cover the arch was made from material taken from the trench. The rest was clay brought in on wagons, and clay and cinders brought in on cars by the Chicago Junction Railway Co.

In order to make the crossing at the west end of Bubbly Creek, it was necessary to construct a cofferdam across the channel and also dam the West 39th St. conduit. The contractor elected to build an earth dam across the channel, on the ground that the bed had been dredged down so close to hardpan that timber or steel sheeting would have too little penetration to render that method practicable.

Fully 75% of the clay excavated from the 9-ft. section of the sewer was used in building the dam. The clay was loaded by the shovel into 3-yd. side-dump cars on a 42-in. gage track along the river side of the cut in trains of four or five cars. The dam was first carried out about 20 ft. by dumping alongside the track and spreading the material into the river by hand, the track being kept out as close as possible to the edge of the slope. When the limit of this method was reached, a timber crib was sunk 30 ft. beyond this fill and the track carried over onto this. As soon as the fill reached the first crib, another was sunk 30 ft. farther on, and so on for the total distance of 150 ft.

Core of Sand Bags Built

A core of sand bags was also built up as the clay sank; and after the fill had been completed across the river, dumping was continued for several days with trams, which further consolidated the material. There was considerable lateral movement of the dam when the water was first lowered, most of it seeming to be at the bottom. This was probably due to the pushing out of the bottom muck that was not entirely displaced by the heavier material. Dumping with trams and wheelbarrows was continued until the movement stopped. The dam was given a top width of 12 to 16 ft. and was carried 3 ft. above normal water level, making it about 20 ft. high. The extra gang employed in building it averaged 12 laborers, a foreman and one team.

In order to close the 12x14-ft. West 39th St. conduit, two bulkeads of tongued and grooved lumber were built

n it through an opening cut in the concrete arch. They were 3 ft. apart at the top and came nearly together at the bottom. The space between them was puddled with clay. Sand bags were piled behind the upstream bulkhead, and as a safeguard a third bulkhead was built about 4 ft. downstream from the second, and sand bags were kept on hand to fill the space between. Fortunately, the need for this did not develop.

The end of the creek behind the earth dam was dewatered by a 6-in. pulsometer, a 6-in. steam-driven centrifugal and a 9-in. electrically driven centrifugal pump. There was no trouble in lowering the water to the top of the soft muck. Two rows of 12x12-in. stringers, 18 ft. apart, were then ranged along the line of the sewer and well braced. Outside of the stringers a single line of 3x10-in. tongued and grooved sheeting was driven by hand through the muck to the hardpan. The pulsometer then pumped the muck as dry as possible.

Hand excavation was started at the south end and carried across in sections of 24 to 36 ft., each section being protected by a cross-bulkhead. Crossbracing of 8x8-in. timbers was put in as required. The greatest depth to hardpan was 19 ft. below river level. The concreting of the foundation and piers was done as soon as each section was cleaned out.

Concrete and Brickwork

All concrete material was delivered on track alongside the work, unloaded by hand and wheeled to the mixers as needed. On account of the extreme top width of the trench, a material scaffold was maintained along the south side of the trench, supported at one side by the bank and at the other side by posts resting on the bottom of the trench. This was moved ahead as the work progressed.

Concrete was mixed by a 10-ft. Knickerbocker mixer. This was operated at the top of the bank opposite the section being concreted, except where the work was inaccessible to the mixer, as when the adjacent buildings were too close to the trench or at the river crossing. At first the mixer discharged into a swinging trough, suspended from the mixer frame and leading to a flexible pipe chute, hung from the material scaffold so as to discharge onto the bottom of the trench. This plan failed to work successfully, because the top cut was usually so wide that the swinging trough could not be given sufficient slope to allow the concrete to flow readily. Thereafter, two-wheeled concrete buggies were used to carry the concrete along the material scaffold from the mixer to the pipe chute. This arrangement made it possible to move the mixer much less frequently, but the concrete had to be shoveled across the full width of the base.

Concreting was done in 26-ft. sections, a wooden templet being set as a bulkhead at the farther end. The concrete was shaped with shovels to the invert curve, as governed by lines stretched from the templet back to the completed work. No attempt was made to obtain a smooth finish, as this was furnished by the tile lining. Two bottom concreters spread the concrete, placed the reinforcement and shaped the invert. On top of the cut were a mixer operator, four or five laborers wheeling stone and sand, one tending the mixer, two wheeling concrete, and one man at the chute.

In laying the invert tile the best results were obtained by laying them on the concrete bottom ahead of the brick arch, after the concrete had set (Fig. 2). However, because of delays in shipment, most of the tile were laid after the arch had been completed, holes being left for lowering the tile and mortar. A templet, cut to the curve of the invert, was blocked up to the proper grade on the concrete bottom at the end of the section to be laid, and the tile were laid in mortar to lines stretched from nails on the under side of the templet to the corresponding joints in the section previously laid. The joints were afterward filled by brooming in a thick grout.

Steel centers of the Blaw type, operated on a traveler, were provided instead of wooden lagging for the brickwork. Figs. 2 and 3. They were built up in 26-ft. lengths, two such lengths being used on the 7-ft. section and one on the 9-ft. The traveler ran on a track laid on the concrete bottom. The rear form would be lowered on the traveler jacks, run through the form ahead, raised into position and blocked up, after which the traveler would be run back for the other form. For the single lengths on the 9-ft. section the traveler was kept in place all the time, and the form moved ahead in the morning before the bricklayers had started work, making it almost unnecessary to point up inside or strike the joints. Four form men easily kept the forms ahead of the bricklayers.

Mortar for the brickwork was mixed in a Lakewood continuous mortar mixer. It was a 1:1 mix of portland cement and screened sand; 10% of lime putty was permitted for ease in handling. Where the mixer was close to the work, the mortar was carried in buckets directly to the bricklayers. Otherwise, it was carried in concrete buggies to a wooden mortar box close to the work, where it was kept well worked up and carried in buckets from there to the bricklayers. The average gang was six bricklayers, three tenders, six tossers, three mortar carriers, one mortar mixer and three to five laborers.

The sewer was built by the Ready & Callaghan Coal Co., of Chicago, under the direction of George M. Wisner, Chief Engineer of the Sanitary District of Chicago, and Langdon Pearse, Division Engineer. The writer was resident engineer.

Engineers Needed in Real-Estate Deals

Engineering in relation to real estate was brought up at the annual-meeting of the Iowa Engineering Society in a paper by R. B. Slippy, of Waterloo, Iowa. In the purchase of property, the abstract of title is submitted usually to an attorney for investigation as to legal defects that might invalidate the title to greater or less extent. It should be equally important to have a report from an engineer showing that the lines of the property are in accordance with the descriptions of the deed, that buildings do not overlap the lines, and that there is no reason for dispute as to boundaries or area. In city property it would be well also to have a report on the water, sewer, gas and electric service, the sidewalks, and as to whether the buildings are in accordance with building and sanitary ordinances. Instances were given of troubles which might have been avoided by such a system of engineering investigation in transfers of property. The city-planning aspect of the relation of engineering to real-estate matters was presented by Prof. L. S. Smith at a joint meeting of the Engineering Society of Wisconsin and the Wisconsin Real Estate Association. This applied to street layouts, building design, civic centers, etc., as well as the more strictly engineering factors of water-supply and sanitation.

THE ENGINEER IN FIELD AND OFFICE

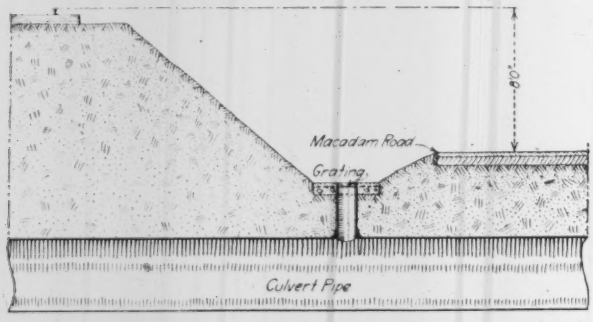
A Department Devoted to Details of the Day's Work

Drop Inlets for Culverts Solve Problem Where Highway Parallels Railroad

By C. S. BENNETT

Highway Engineer, Greenup County, Kentucky

IN CONSTRUCTING a section of a state-aid road in Greenup County, Kentucky, the highway paralleled the railroad for a distance of one-half mile. The railroad fill being 8 ft. higher than the road surface for about half of



DROP INLET TAKES CARE OF DRAINAGE WHERE RAILROAD PARALLELS HIGHWAY

this distance, a difficult problem was presented of disposing of the road drainage.

As all culverts extended through both fills, it was decided to adopt the inlet method used on paved roads and streets. Excavations were made in the ditch line over the existing pipe culverts, all of which were 48 in. in diameter and of corrugated iron, and a section was sawed out of the top of the pipe. Short sections of 12-in. corrugated culvert pipe were then placed on end, and fastened to the large pipe by means of an easily made metal collar through which several bolts were run. The top of the riser pipe was provided with a concrete apron 6 in. thick, the width of the bottom of the ditch, and extending about 3 ft. along the ditch. A few small reinforcing bars were inserted in the green concrete, and formed an effective grating which excluded foreign materials. The design has proved very satisfactory and was used in several instances.

Paper Can Replace Hemp for Pipe Joints

Pipe-joint materials became so scarce on account of the war demands that R. Moor, Zurich, Switzerland, devised a paper packing for joints of cast-iron and steel pipes. Such joints have been tried out by Guggenbühl, Müller & Co., of Zurich, according to the *Schweizerische Bauzeitung* of Feb. 3, 1917.

The packing is made of rolls of newspaper, conical in form, 6 in. long, ¼ in. to ½ in. in diameter, nested together and pasted. They are waterproofed by impregnating with tar oil. They are flexible and compressible and can be driven very tight with a calking iron. A ¾-in. lead joint is poured over the paper, but even without this such joints held a pressure of 750 lb. per sq.in. after 14 days in water!

How Catalogs and Pocket Maps Are Filed in an Engineer's Office

By RUTH CANAVAN

Librarian for Metcalf & Eddy, Consulting Engineers, Boston, Mass.

SOME of the material to be filed in an engineering library, particularly trade catalogs and folded pocket maps, is so diversified in size and shape that it is hard to handle. Thus, while it has come to be generally conceded that trade catalogs ought to be unified as to dimensions, and while this would be of advantage not only to the possible purchaser but also to the manufacturer, the catalogs continue to vary from the flimsy leaflet to the substantially bound volume. Yet, as the engineer uses them in making estimates of cost, in selecting equipment, and in other ways, he must have them readily available and well indexed.

The general indexing schedule in use in this library is a form of the decimal system, by which the books and data are assembled under various classifications according to subject matter. This modified Dewey system was found to be too detailed for application to the trade catalogs, and it was necessary to simplify it; that is, K 6, Water Works Distribution System, including in its subdivisions the subjects of pipes, valves, distributing reservoirs, conduits, meters, etc., became in the simplified schedule, K 6, Water Works Pipes and Valves; while K 6.5, Meters, became more comprehensive and included Measuring Devices for Water.

Unifiles Adopted for Filing Trade Catalogs

Within each classification it was decided to maintain an alphabetical sequence of the catalogs, according to the names of the firms issuing them. To do this an exceedingly flexible filing device was necessary, since it was planned to place the material without regard to size and shape and without segregating the bound volumes. Pamphlet boxes would have meant considerable waste space, and vertical files either the segregation of the bound volumes or an unwarranted expenditure for filing units. Heavy manila envelopes were also considered for the filing of the leaflets and pamphlets, but were found undesirable both because they were incommodious, and because when the envelopes were stacked the exposed ends offered no surface for indexing.

Type of Containers

It was decided to use the unifile. This is a pasteboard receptacle open at the top, containing cardboard folders with tabs, such as are used for filing correspondence. The containers come in two widths, 1 in. and 1½ in., and are 12 in. long—just the depth of the open shelves upon which the catalogs were to be stacked. The exposed end of the unifile is curved and is covered with heavy brown paper. Upon this a sticker, bearing the classification number, was placed. Except in those instances where a whole container was devoted to the catalogs of a single firm, the indicating of the contents of the unifile upon the end was avoided, so that as new material was added the card-

board folders could be shifted. On the tab at the top of each folder, however, the name of the manufacturer and the classification number were placed, while on the bound volumes and the thicker of the pamphlets strips were pasted with the firm name.

In connection with this file a card index of the names of the manufacturers was maintained, with the classification number, or numbers, under which the catalogs of each firm were to be found. It has proved extremely useful to include also in this index the trade names of materials, since these so often differ from the name of the manufacturer or of the firm issuing the catalog. As the catalogs are assembled according to subject matter, a subject index has not been found necessary, but reference to an advertising index is made when doubt arises as to the manufacturer of some special material. This method has been tried out for five years, in the filing of 16 shelves of catalogs, and found satisfactory.

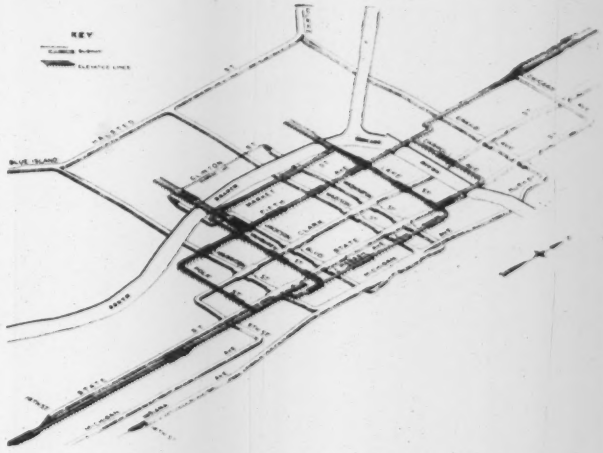
Pocket Maps Filed in Envelopes

From the very fact that they are designed to be tucked away, the pocket maps are likely to be tossed into a desk drawer or placed in a pigeonhole and forgotten. It is wise, therefore, to have a file of them in some conspicuous place where they will be readily accessible and will not be overlooked. Like the trade catalogs the pocket maps vary in size and shape, for while some seem designed for the coat or outer pockets, very many are long and flexible and of a form suitable for the vest or trousers pockets. A simple device for maintaining a neat and uniform file of such maps is the heavy manila envelope of standard size (4½ in. by 10½ in.) with its flap removed and a cloth tape tab 1½ in. in length pasted on the closed long edge. On this tab the brief title of the map is written. The envelopes are filed on end in alphabetical sequence of the titles of the maps. The tabs are bent to one side and as they have been pasted at varying intervals on the long side of the envelopes it seldom happens that they overlap. If it should chance that a map is too long for an envelope, the latter may be slit at the top end. This file is kept in a glass-front case and stacked by means of tin rack ends. Rack ends placed behind the envelopes will keep them from slipping back on the shelf. In the general card catalog of material in the library, the maps are listed under the subject "Maps" and also under the individual titles.

Complicated Transit Plan Made Clear by Isometric Perspective

The use of an isometric drawing to show the elevated and subway lines of the rapid-transit system proposed by the Chicago Traction and Subway Commission is an interesting feature of the commission's recent report. This drawing is reproduced herewith.

Maps are used freely in the report, but even with the assistance of symbols and colors these fail to give so graphic a representation of the lines in their comparative relations as is given by the drawing. The difficulty of showing these relations by a map is increased from the fact that the elevated lines have double-deck portions to separate grades at intersections, while the subways include lines at two different levels, with inclines connecting them and also connecting the subways with the surface and elevated lines. These details are shown clearly on the drawing, which also indicates the positions of the stations.



CHICAGO TRANSIT COMMISSION MAKES EFFECTIVE USE OF ISOMETRIC PLAN TO SHOW ITS SYSTEM

Further, the view (10 in. long in the original) is as understandable by the layman as by the engineer, which is an important advantage in connection with a project of this kind that has to be submitted to various officials and public bodies.

Small Portable Plant Pumps Water for Road Contract

A quickly moved portable pumping plant for contractors is shown in the accompanying illustration as used by Walters & Windes, of Glencoe, Ill. It is made up by mounting a 12-hp. gasoline engine on a four-wheel steel truck with a Goulds single-acting triplex 3½ x 6-in. plunger pump.

The truck is wheeled to place near the source of supply and blocked up by planks under the axles, which are square, so that the load is taken off the wheels. As shown, the unit is used for supplying water to roadwork on the Milwaukee roads in Cook County, Illinois. The pressure line is of 2½-in. pipe and has tees provided every 100 ft. so that 1-in. hose connections can be made.

PORTABLE PUMPING PLANT SUPPLIES WATER FOR COOK COUNTY ROAD JOB

What the Chief Draftsman Can Do To Promote Teamwork

By W. FRED DOLKE, JR.
With Lockwood, Greene & Co., Engineers, Boston, Mass.

THE engineer's scientific and accurate methods of investigation and report, ordinarily applied to every subject under the sun except his own drafting room, can profitably be directed at the functions and duties of the chief draftsman. As a starter, a few suggestions are offered in the following.

The writer went through the experience, with one firm, that no matter how well or carefully a design might be worked out, the "boss," with no knowledge of the many little points which actually were the determining features in the design, would change it. As a natural result the tendency of all the draftsmen was to put down anything—and let it go at that. In similar manner it is true quite generally that upon the temperament, abilities, energy, and personal efficiency of the chief draftsman the efficiency of the entire force of draftsmen will depend.

Efficiency experts have agreed that the prime requisites for any position of responsibility are health, intelligence, honesty, industry and personality. In addition, the chief should know his business, and at least be a good enough draftsman so that he can do a thing better than a subordinate—in the sense that he knows how to get it done, and knows when it is done in the better way. Too frequently a man is made chief because he is a corking good draftsman, although he does not know the business, nor does he know how to run it.

Efficiency Studies by Chief Draftsman

The chief draftsman is the controlling efficiency engineer of the drafting room. He should gather from all available sources whatever is of operating value for the organization he is guiding. He should follow up daily the work each man is doing. He should compile records of men and of details, of cost and of efficiency, and should relate records of today to records of yesterday, securing similar records if possible from other concerns. Records should be kept of improvements made, of gains in time, work, or material accomplished by all changes—not merely for the immediate satisfaction, but for future guidance. Only on the basis of all these records is it possible to determine necessary changes properly or certainly, to create standards, and to reward the efficient.

Standardization Has Its Limits

Many drafting-room details are subject to standardization. For instance, if drawings be made to a few standard sizes, paper and cloth can be bought cut to size with borders and standard titles printed on the back. How much time did your men spend last month cutting sheets, drawing borders, and lettering titles? And how much material did they waste? Do your tracers know that time and energy can be saved if they put in all curved lines first, circles next, then all horizontal lines, and vertical lines last; then all arrowheads, figures, lettering—all in order? Do all of one kind of work at the same time—and let the office boy fill ink bottles and make wholesale erasures. And, by the way, modern drafting machines are far ahead of T-squares and triangles.

All standardizations should be reduced to writing. If harbored in the mind of some older employee to transmit by word of mouth, they are just as likely not to be transmitted. With good records and standard practice data in his hands, a new chief can replace the old without causing the slightest disturbance in the progress of the organization.

In every efficient organization there is somewhere, in an understandable form, a statement of what the firm stands for, a definition of its policy, a reflection of that individuality which marks it off as different from other firms. No man can be loyal or work most efficiently unless he knows what the firm is, what it wants done, what it will or will not do with regard to the many questions calling for decision. Let you draftsmen benefit through understanding the firm's ideals.

Hire and Fire Only After Thorough Study

When the wheels get clogged with an increase of work, the average chief draftsman thinks "more men, more work." Having never stopped to study his force, he doesn't know whether his men are working to capacity, or whether his methods hamper them. But the modern manager, knowing that a new man disturbs routine, that it costs money to hire and train him, may avoid taking on a newcomer until his force cannot by any possibility increase its production.

When it is finally necessary to find an additional draftsman, first determine definitely the qualities necessary in the position to be filled, and then subject the applicant to a searching inquiry that will reveal not only all the details of his training and experience, but also his habits and his methods of thought. He should be studied for his abilities in speed, accuracy and clear thinking—in other words, be put through a thorough examination. Also, in the true spirit of fair play, the applicant should be given a thorough explanation of the ideals of the firm, of the organization and its methods, so that he can determine whether he cares to live up to the rules of the game as played in that particular place.

In this connection, let it be said that nothing so injures the reputation of a firm among the great body of draftsmen upon whom it must depend, as a policy of "hire and fire."

Take the Trouble To Train a New Man

In too many offices the new man is assigned to a table, given a job to start on, and then left to his own devices. It sometimes takes him weeks to get properly on his feet, to get in tune with the rest of the force—if in the meantime he hasn't been fired as "an incompetent," or "a failure." Is the man always to blame? Has he been given a chance? Why shouldn't the newcomer be the special charge of the chief, or of the most efficient draftsman in the place, and be given thorough, complete and intelligible instructions from the beginning? If he has been worth hiring, isn't he worth a little trouble? Isn't it better to pay for a few hours' instruction than to settle for hours of blundering?

After a man learns to do a thing he should be taught to think about what he has done. In every organization a fair percentage of employees want to improve. These men should be encouraged, and it should be the chief's duty and pleasure to study his men's needs, to talk over with them their problems, to have his standards of success so analyzed that he will be able to show the "failures" where the trouble lies.

EDITORIALS

Promoting United Action

THE Conference on Engineering Coöperation which met last week in Chicago, assembled at a time when the need and the opportunity for united sentiment and action on the part of engineers, as well as other bodies of patriotic citizens, is echoing from one end of the country to the other. The keynote of the conference was given by the address of J. S. Dennis, president of the Canadian Society of Civil Engineers in his description of what Canadian engineers had done in the war crisis and was again sounded by H. M. Byllesby in urging the present need of concerted effort for the common welfare. It is significant that by spontaneous action many engineering societies have been moving along similar lines during the past year; but the need is none the less obvious that plans for systematic and permanent coöperation should be devised and carried into effect.

Engineers Are Patriotic

THERE has been abundant evidence during the past year of tense international relations that the engineers of the United States could be counted on for loyal service to their country and for whatever sacrifices the country's necessities might demand. During the last few weeks many engineering societies have by action of one sort or another expressed the sentiments of their members on the great questions which have been before the country. On page 58 is printed a summary of what the principal societies have done, either to express the sentiment of the membership or to contribute toward actual work for preparedness. No one can read the vigorous resolutions adopted by these organizations of engineers without a thrill of patriotic fervor and the realization that with such devotion to the country's welfare there is only needed strong and wise leadership and the same intelligence in handling men and material that American engineers have displayed in civil pursuits to lead the country safely through the trying times ahead. The account of what the engineering societies are doing is, however, only part of the story. The leading engineering schools of the United States have been no less prompt in placing their facilities and their men in condition to be made use of for the country's defense. We have obtained from the leading engineering schools statements of what has been done by them in this direction, but lack of space compels delay in the publication of these responses until the next issue.

No Building Is Fireproof

THERE is no absolutely fireproof structure. The truth of this oft-repeated assertion must be borne in again on such doubters as read on another page of this issue the story of the Quaker Oats fire in Canada. There was at Peterboro a reinforced-concrete structure of the most approved type. Its windows were all of wire-glass; its doors and openings were all protected. There were no beams and girders to spall and break because of sharp corners. As far as the construction of the building alone was concerned, it represented the highest type of the fire-protection art. Ten hours after the start of a near-by fire this fine structure was in ruins, nearly half of it had collapsed, its entire contents were destroyed, and the remaining fragment was worthless as a building.

Does this mean that it is useless to attempt to build fireproof structures? Most certainly not. It means that proper conditions of exposure and contents can give rise to a conflagration that no building can resist. Efficient fire protection means much more than a fire-resistant building. It means proper water-supply for mains and sprinklers, a trained force of watchmen and fire fighters and proper isolation from near-by structures whose construction is such as to invite a fire.

It is in these latter particulars that the Quaker Oats plant was at fault. The water for the supply system was so arranged as to be easily put out of service by a fire breaking out in parts of the plant that were far from fireproof—in fact, were of only moderately fire-resisting construction and contained material of the highest inflammability. A fire once started in the cereal content soon reached temperatures no material could resist.

That is the whole story of the destruction of the concrete warehouse. Its additional interest lies in the fact, possibly not so well known as some others, that concrete will give way when subjected to terrific temperatures. The efforts of the designer, then, must be directed not only to the efficient fire-resistant design of the concrete building itself, but also to the outlying conditions which may subject that building to temperatures that under no possibility will it be able to withstand.

Overhead Bridge Design

WHEN a bridge over a railway has to be squeezed in between hampering limits of track clearance below and street grades above, its design sometimes becomes a hard problem. It is doubly hard when an artificial limitation is superadded to the space difficulties. Thus, in designing the Cambria St. bridge over the Philadelphia & Reading tracks in Philadelphia, where the space margin was very small, the engineers were additionally limited by the requirement of building a deck bridge. To their credit, be it said, they worked out a successful solution, as is evident from the description of the bridge on another page of this issue.

The advantages of deck construction are obvious—we speak now of the æsthetic advantages, which were the decisive ones in this case. Yet the demand for a clear floor is sometimes unfair to the possibilities of the through bridge. Very satisfactory designs can be made and have been made, under similar conditions, with trusses or girders above the roadway. The problem encountered at the Cambria St. crossing has been met many times in other places, and numerous through bridges of very pleasing appearance have been built.

It is necessary that the æsthetic phase of the problem be kept specially in mind, and it may need some competitive effort to bring out the best solution. This much is certain, however: Through-bridge solutions are possible that in no way yield rank to deck constructions in point of beauty.

The governing reason for adopting the deck type at Cambria St., if we understand the case rightly, was that other bridges over this cut are deck bridges. It is the argument of uniformity, which does not lack force. But æsthetic requirements may be satisfied even with diversity of form, if the choice is guided by the right architectural perception.

However, in view of the successful result of the Cambria St. design, this comment is academic, perhaps, rather than immediately pertinent. It is a fact that the demands of strength, due protection from smoke gases, and pleasing or even monumental effect were well harmonized.

The Nation Needs Engineers

AT THIS time of national emergency, when engineers from one end of the country to the other are asking what practical thing they can do to aid in the work of national defense, we have taken pains to ascertain, from the most authoritative source, what is the most useful service that engineers can now perform.

And the answer is that the immediate need, which engineers are asked to supply, is skilled men to enlist in the engineer reserve troops of the army. Everybody knows now the great importance—the absolute necessity—of efficient engineer troops in modern military operations. The United States needs such troops and needs them now.

The various engineering societies have done splendid work in months past to provide for the ultimate mobilization of all the nation's resources for defense. But now the conditions have changed, and we must face the situation that for all practical purposes *we have no fighting machine*. Engineers are asked to coöperate at once in creating such a fighting machine, and the appeal made here is to all intents official.

The National Defense Act of 1916 authorized an officers' reserve corps and an enlisted men's reserve corps for the technical branches of the army. About 500 men have been commissioned, or recommended for commission, in the Engineer Officers' Reserve Corps. Gen. William M. Black, Chief of Engineers of the Army, is now endeavoring to organize reserve units of enlisted men, skilled in the engineering trades, who will be officered from the Engineer Officers' Reserve.

Months can be saved by building up at least skeleton organizations, but lack of appropriations and authorization prevents the army officers, either regular or reserve, from going out and recruiting. The voluntary efforts of engineers, as patriotic citizens, must be relied upon to secure enlistments.

The reserve engineer forces will be trained for pioneer duty (trenching, mining, road making, bridge making, etc.) with combat troops. Such engineer troops are subject to the President's call in case of war and are to give fifteen days annually for training. The best recruits for engineer troops are the skilled workers in the manual trades, such as are found in every large contracting or railroad organization and with many industrial concerns. Superintendents, foremen and gang bosses will make good noncommissioned officers.

These reserves may be organized in local units. Some large concerns may find it possible to raise a platoon or a company or even a battalion among their own men. A local platoon or a company may be organized through the coöperation of several employers in the smaller industrial districts. The larger districts should furnish companies, battalions and even a regiment.

All this can be done in peace times without materially affecting the industries, for each engineer company is selected from a wide variety of skilled workers. The larger groups in an engineer company of 109 men (peace strength; war strength is 164 men) are the civil-life surveyors and draftsmen (12), miners and quarrymen (11), carpenters (20), mechanics (14), axmen (8), teamsters (10), etc.

At present, of course, the sole reliance in securing men is voluntary enlistment; but the stirring times through which we are passing will surely bring a patriotic response from men in every walk of life. Emphasis is now laid only on recruiting for the reserve organization; but everyone realizes that the reserve, when trained, would be called upon for service in advance of raw volunteers.

During training or service the Government furnishes equipment and subsistence and gives the regular army pay, while the skilled noncommissioned officers receive considerably higher pay. Some employers have already expressed their intention to make up to their men, during training in the engineers' reserve troops, the wages which they would have earned at home. The state legislatures are showing a willingness to make such payments during war service as would be the equivalent of separation allowances.

How may the engineers and employers proceed who wish to make a patriotic response to this appeal? They have only to size up their own situation, ascertain conservatively the number of men available and their qualifications, and get into communication with the Chief of Engineers' Office at Washington. The further steps required will be explained from that office.

No one doubts that any call of the President for volunteers for national defense will meet prompt response when it comes. It is the special responsibility of engineers to see that skilled and trained engineer troops, which are as necessary to effective military service as guns and ammunition, are ready at the earliest possible moment.

The New Technical Journalism

THERE never has been, in all the history of technical journalism, such an opportunity as is now open to this journal, *Engineering News-Record*. No other technical journal has ever achieved anything like so large a list of subscribers. And these readers, to an extent seldom equaled, regard the journal as a friend and helper in their daily work. They look to it to represent and defend their interests and to assume leadership in every movement for better practice and higher standards. Most of these readers are men of education and experience. To conduct a journal worthy of such patronage is truly a heavy responsibility.

At the time of this new departure it has seemed well to set forth some of the principles which, by a process of evolution, have come to control the conduct of the publications that have united to create this new journal, and which must continue to guide in the future.

The first of these principles is that the highest success can only be gained through the friendly coöperation of those whom we seek to serve. There are, probably, in

the United States over a hundred thousand men engaged in various branches of civil-engineering work in positions involving more or less responsibility. These men are all the time discarding old ways and finding improved methods and apparatus for doing their work. Experience is all the time teaching new lessons and enforcing old ones.

It is necessary for the civil engineer to keep abreast of this progress, and it is the duty of his professional journal to aid him to do this; but in order that this task shall be accomplished, the journal must have the coöperation of the men who are doing the work.

Its editors, through their various channels for news gathering, may hear something concerning some of these forward steps, but in very many cases the only possible manner in which they may obtain the information is through the voluntary action of some engineer directly connected with the work.

The United States covers a vast area. Things of interest to the civil engineer are happening daily in many parts of it and in foreign lands as well. In order that this journal shall properly fulfill its great function as a coöperative exchange, where developments in civil engineering worthy of record shall be properly made available to the whole profession, the engineers scattered from Maine to California must in the future, as they have in the past, voluntarily contribute from their experience for the benefit of their fellows.

And the extraordinary audience that *Engineering News-Record* now reaches furnishes a great incentive to such coöperation. It is truly a great opportunity for any engineer to be able to reach such a wide circle of the profession with the story of what he has achieved.

In this connection it is well to note a second principle, which has played an important part in the development of this journal and which may well be emphasized here. That principle may be tersely stated as giving credit where credit is justly due.

There have been some sadly misconceived notions on this point among engineers. It has been claimed, for example, that papers which were read before technical societies and which brought commercial benefit to their authors or to any concern mentioned in them were unprofessional and ought to be excluded.

It needs but a little thought to see that this principle, if carried to its logical conclusion, would eliminate from engineering literature most of the useful matter and would leave little but dry-as-dust researches in so-called pure science.

In contrast with this warped idea of professional ethics is the principle enunciated above, which holds that the author of a paper is entitled to all the honor and credit among his professional brethren that may result from having his name placed at the head of his contribution; that the engineer who has borne the responsibility for the design and execution of a work, the contractor who has made it a reality, the inventor whose genius has produced a worth-while improvement, the manufacturer who educates the public to its use, are each entitled to full credit.

And there is another sound reason for thus giving due credit. It is that the authority for the data presented in an article may be definitely fixed. An engineer who wishes to make practical use of information that he finds on the printed page is entitled to know definitely who is responsible for it or what engineer prepared a design or erected a structure.

There is another principle governing the conduct of this journal that is a necessary result of the very large circulation which *Engineering News-Record* now commands. The emphasis must more than ever be placed on quality rather than quantity. If one is speaking to a dozen guests around a dinner table, he may content himself with offhand remarks made without previous preparation. If a speaker has to address an audience of a thousand, he will take pains that every sentence from beginning to end shall tell a clear story to its hearers. One who speaks through the pages of *Engineering News-Record* can make a hundred thousand engineers listen, if his message is sufficiently important and is delivered in a way to command the reader's attention.

To put it another way, it is well worth while, as a mere matter of labor saving, for a writer to study painstakingly every word and sentence if thereby he can make his message easier of comprehension by each of the many thousand readers to whom it is addressed.

Probably few engineers fully realize what an enormous increase there has been in the volume of engineering literature in the past quarter-century. It is not so many years ago when long and elaborate monographs read before the engineering societies were printed in full in *Engineering News* and the *Engineering Record*. There is no longer room for such papers. The rapid extension of the civil engineer's field of work and the necessity of adequately covering these various fields leave no room for such lengthy monographs in the up-to-date technical journal. Such papers must find their place in the proceedings of the engineering societies.

It has long been and will continue to be the aim of this journal to promote in every way possible the aspirations of engineers for larger responsibilities and greater usefulness. It is with this view that the editors seek continually to make this journal broad in its scope. The engineer who reads his technical journal merely to gain its aid in the particular work on which he happens at the time to be engaged is missing a large opportunity; and although he may not himself realize it, he is placing a bar in the way of his own future advancement. The different fields of engineering work are not separated from each other by water-tight compartments. On the contrary, it is continually happening that progress made in one field opens the door to progress in other widely different fields.

In the development of commerce and industry and governmental activity in the years just before us, the technical work of the engineer is certain to play a large part. The engineers who add to their technical knowledge and experience executive ability and breadth of view will be called upon to assume places of large responsibility.

This journal will promote in every way within its power the selection of engineers of proved ability for important executive and administrative positions, not merely for the sake of the profession, but for the great public interest at stake. In that rapid process of history making that has gone on for the past three years, the masses of the people have come to understand as never before how much are national prosperity and national existence dependent on the ability and character of those in responsible control of government and of industry. The engineer's reputation for fidelity to trust, for efficiency and for scientific thoroughness is slowly but steadily winning for him a larger measure of public confidence.

Engineers Indorse "News-Record" Consolidation

Congratulatory Messages Express Faith in the New Journal's Ability To Serve the Best Interests of the American Engineer and Contractor

Our friends have been most generous in expressing their appreciation of the past work of "Engineering News" and the "Engineering Record," and their faith in the future of the consolidated journal. The cordial co-operation and support that we have received in the past have been our greatest inspiration, and it is our confidence in their continuance that gives us courage to undertake the larger responsibilities of the future.—THE EDITORS.

GEORGE H. PEGRAM

President, American Society of Civil Engineers; Chief Engineer, Interborough Rapid Transit Co., New York City

Engineers will view the disappearance of the individualities of the two papers which have done so much for engineering, almost with the feeling of the loss of friends. "Engineering News" was long our only American engineering authority; and its high character has been maintained from the start, even in periods when there was practically no competition. The "Engineering Record" of much later birth soon won its way to the front.

The consolidation of "Engineering News" and the "Engineering Record" into a single publication will benefit the profession in giving it a single organ to speak on matters of professional policy and public relations, which is especially needed now when the effects of the great world war are tending to change the organization of society. While we cannot hope for the combined wisdom of the two papers, the concentrated effort should not only give better results, but will avoid a confusion of counsel.

GANO DUNN

President, United Engineering Society; President, J. G. White Engineering Corporation, New York City

Engineering owes a debt to each of the two leading journals that have consolidated. They have been responsible for giving to the office and to the field much more than news. They have for years been welcomed on our desks and in our camps. Their editorials have been written by, and usually their contributed articles have been selected from, men who saw the implications as well as the bare facts of their subjects. The great movements in the last few years taking place among engineers as a profession owe an indefinably large obligation to the editors of the two journals and to their immediate staffs for the constructive ability they have contributed through their personal counsels and for the tremendous influence of the engineering public opinion they have caused to be brought to bear. As a strong arm of engineering education and as an appreciated source of light and leading, the future of the new journal is bright.

GEORGE GIBBS

President, American Institute of Consulting Engineers; Consulting Engineer, P.R.R., New York City

I am glad to hear of your plans for an enlarged field of usefulness for "Engineering News" under its consolidation with the "Engineering Record." These journals in the past have been necessary in every engineering office, covering as they did the field in civil engineering and in construction which is not covered by any other American publications. The consolidation is a logical one in these days of centralization of effort and should make for efficiency in the collection of news and in its dissemination. I wish you every success and shall look forward to the enlarged journal with interest.

A. W. DEAN

President, American Road Builders' Association; Chief Engineer, Massachusetts Highway Commission

I have noticed that "Engineering News" and the "Engineering Record" are to be consolidated; this information cannot but be pleasing to all busy engineers. Each magazine has been very valuable. The field covered by each overlapped the other, so that the consolidation should make one unexcelled engineering weekly, a great convenience for those who do not have the time or opportunity to read as many magazines as they would like.

LEONARD METCALF

President, American Water-Works Association; Consulting Engineer, Boston, Mass.

My partners and I send hearty congratulations to you upon the consolidation of "Engineering News" and the "Engineering Record." Engineers will watch the development of your plans for the future with great interest.

The standard of service long maintained by these journals, which has been of inestimable value to the practicing engineer, the contractor and the teacher, has been a very high one and has done much to advance the state of engineering knowledge and of the art of construction. Fair play, honesty of purpose and general freedom from the degenerating influences of commercialism have marked these journals, and engineers who have had the privilege of knowing the members of their editorial staffs have valued not only their friendship but, more important, their sturdy character, sound judgment and fearlessness in the pursuit of fundamental truth. The perpetuation of these ideals of service to the profession and the advantages to be derived by this union of two great engineering periodicals, place upon you a heavy burden of responsibility for the future, to which you are fully alive.

Engineers will hope that your plans may be rewarded by full measure of success.

W. K. HATT

President, American Concrete Institute; Professor of Civil Engineering, Purdue University

I warmly welcome the consolidation of "Engineering News" and the "Engineering Record." Each journal has notable individuality. It is presumed that the consolidation will preserve the effective elements of both.

I have always felt that "Engineering News" represented the high professional ideals of the past generation and was distinguished by a critical mood, while the "Engineering Record" was somewhat more progressive, with helpful sympathy toward all large movements affecting the interests of engineers. The combination of these two characteristics is appropriate, and can be made without loss to either.

The correspondence column of the "News" has always been interesting and valuable. Its book reviews have been especially good.

The consolidation is also a measure of economy as far as the subscriber is concerned. I wish that some such movement could take place among the various engineering societies, either in consolidation or apportionment of field of effort.

W. M. BLACK

Brigadier-General; Chief of Engineers, U. S. A., Washington, D. C.

The consolidation of the "News" and the "Record" brings to the busy engineer a measure of the relief found when two separate telephone companies of a single territory are united. While the two were separate, both had to be consulted. Each had its special field of work, and each covered in part the field of the other.

The work of both has been excellent. We older men of the profession can remember easily the difficulties encountered before we had placed before us week by week in the pages of the "News" and of the "Record" the experience gained by others. How often we each had to experiment blindly along paths novel to us, sometimes to ultimate success, but sometimes to failure, without the light of each other's experience excepting that chronicled at long

intervals in society proceedings or so old as to become embalmed in text-books.

May the consolidated journal continue the good work heretofore accomplished, and may it have all prosperity.

ADMIRAL F. R. HARRIS

Chief of the Bureau of Yards and Docks, Navy Department, Washington, D. C.

A combination under one cover of "Engineering News" and "Engineering Record," the two leading periodicals in the fields of general engineering and construction, eliminates the duplication of material published, and will undoubtedly serve to present in a more thorough and comprehensive manner the subjects of engineering interest. The combined energies of the editorial staffs will unquestionably broaden and lend additional prestige to the new publication. The consolidation has undoubtedly been prompted by an enlightened sense of progress, and it is confidently predicted that the "Engineering News-Record" will more than surpass its original predecessors in the dissemination of engineering news and in its value to the profession.

WILLIAM H. BIXBY

Brigadier-General, U. S. A., Retired; Late Chief of Engineers, U. S. A., Washington, D. C.

The proposed consolidation of "Engineering News" and the "Engineering Record" into a single journal impresses me very favorably. I have known both of these journals ever since their first issues and have taken great pleasure not only in steadily recommending them to my younger colleagues, but in noting that each journal has always been conducted in a manner most creditable to its editors and invaluable to its readers. At intervals each, in its turn, has seemed a little better than its competitor for special lines of work. However, considerable matter seemed often to be unnecessarily duplicated for the readers of both journals, so that a combination of the two into a single publication should economize services to the editors, cost to the publishers, space, time, eyesight and mental energy to the readers, and should allow of a broadening of its field of work along the newer lines to an extent hardly possible heretofore without lowering the specially high professional standard which has so long distinguished its predecessors.

WILLIAM D. PENCE

Member Engineering Board, Interstate Commerce Commission, Chicago, Ill.

Great journalism—technical or other—implies always the capacity to do the thing, and of course the freedom to do it and the full disposition to use both capacity and freedom. Those who best know the past earnestly hope to see the best preserved and blended in full harmony of action in the new. With all that assured—and the ear well clear of the ground—one easily forecasts great things for the profession and for the journal itself, as a matter of course. "According to me," as Edward Everett Hale used to say, that's precisely what we have a right to and do expect.

ARTHUR POWELL DAVIS

Chief Engineer, U. S. Reclamation Service, Washington, D. C.

I was very glad to learn of the proposed consolidation of "Engineering News" and the "Engineering Record," as this will make available the best talent and facilities of both organizations, avoid duplication of effort and permit continued improvement in results. The high standard reached and sustained by both the "News" and the "Record," together with a constant growth in circulation, attests at once the growing importance of the engineering profession and their appreciation of high standards well sustained.

The safety, prosperity and ultimate destiny of the nation depend largely upon the engineering profession, and hence its own leadership, journalistic and otherwise, is of the highest importance. The consolidated journal promises the best for the profession in this line. You have my congratulations and best wishes.

M. M. O'SHAUGHNESSY

City Engineer, San Francisco, Calif.

I believe that the engineering profession will be materially benefited by the consolidation of "Engineering News" and the "Engineering Record." Heretofore the description of many engineering projects was duplicated each week in these two leading technical journals, which involved a considerable loss of time for the busy engineer. Both papers have in the last 20 years contributed materially to the development of engineering ethics and standards, have emphasized the dignity of the engineering profession and represented its interests with the business communities which have to finance all engineering projects of magnitude.

I feel that the value of the consolidated journal will be more than double that of either separate publication, as the best elements of each will be retained and their united influence will have a marked effect on the development of engineering science in the future of our country.

NELSON P. LEWIS

Chief Engineer, Board of Estimate and Apportionment, New York City

The announcement of the consolidation of "Engineering News" and the "Engineering Record" is of the greatest interest to the engineering profession. The standard of both appears to me to have been raised year after year; and their consolidation into what should be and, I believe, will be the greatest engineering journal in the world will be of enormous advantage to the engineering profession. I wish you abundant success in your larger field of activity.

HUGH L. COOPER

Consulting Engineer, New York City

The consolidation of the "News" and the "Record" has no doubt come as a shock to thousands of their respective admirers, who for years have found much profit and pleasure in comparing the work of two very able editors spurred on by a healthy rivalry that generally produces otherwise unobtainable efficiency. We are asked from now on to transfer the old admiration and pleasure to a "new cover that will contain the strong features of both the old papers," etc.

Engineers generally, and American engineers in particular, greatly need the instruction that comes out of energetic, accurate, technical news descriptions and fearless editorial comment thereon, and will expect much from this new venture so handsomely endowed with brains and money.

MORRIS KNOWLES

Consulting Engineer, Pittsburgh, Penn.

I shall be glad to be among the first to congratulate you and your associates on the great wisdom shown in the consolidation of the "News" and the "Record." All engineers must join in the appreciation of this example of co-operation; and in these days of rapid increase of things to read, you are making for concentration. My own good wishes go with you in the extension of your activities.

F. H. NEWELL

Professor of Civil Engineering, University of Illinois

I wish to express my personal pleasure that the "News" and the "Record" have been combined, as there has evidently been a considerable waste of the time of the readers in looking over two similar publications, and obviously an increased cost somewhere in a duplicated organization. I wish you every possible success in your enlarged work and assure you of the great interest of innumerable friends in your efforts.

W. G. CHACE

Chief Engineer, Greater Winnipeg Water District, Winnipeg, Canada

It is with some regret and with a larger measure of satisfaction that I note the passing of "Engineering News" as an entity. I have observed the progress of both "Engineering News" and the "Engineering Record" with considerable interest. My late partner, Cecil B. Smith, used to speak of the "News" as "the daddy of them all," referring to the American engineering press, and I feel certain that the hitherto great value of your magazine as a record and as a means of discussion can only be enhanced by your recent amalgamation with the forces of the "Engineering Record."

I feel that the next few years will be epoch-making in the development of the American and Canadian resources and in the advancement of the engineering profession to the status

which it long deserved and is now in some prospect of approaching, and I trust that your combined magazine may be of no little value in tracing the history of the one and in aiding the development of the other.

JOHN W. ALVORD

Consulting Engineer, Chicago, Ill.

"Engineering News" and the "Record" are to be congratulated upon the advantages which they will confer upon the engineering profession by the proposed consolidation of these two well-known journals. Those of us who have taken both of these valuable journals for many years past and have so intimately known of the good work which both have done will have no fear but that the new consolidated journal will accomplish still greater things for the good of our profession.

R. KEITH COMPTON

Chairman, Paving Commission, Baltimore, Md.

It is with pleasure that I learn of the consolidation of "Engineering News" and the "Engineering Record." I have been a reader and a student of "Engineering News" for the past 25 years, and of the "Engineering Record" for the past 10 years. Both papers have been a source of great information to the writer. Since assuming charge of the vast paving operations in this city, I have made it a point in seeking outside competition to advertise as extensively as possible, sometimes the advertisements appearing in these papers simultaneously and sometimes alternately, as best suited our convenience. You will see therefore that we have not only through the medium of these two papers kept up with the times, so far as latest methods of construction are concerned, but through these papers and the advertising mediums we have secured the keenest competition on our paving work.

The consolidation of the two papers will be a distinct advantage to the engineering profession, not only in the way of source of information, but as an advertising medium for contracts, in that we will now deal with one large medium handled by the best talent in this country.

ALBERT J. HIMES

Valuation Engineer, New York, Chicago & St. Louis R.R., Cleveland, Ohio

Having been a subscriber to "Engineering News" for about 30 years and a firm believer in the uniform excellence of its policies and their great benefit to the whole engineering profession, it is with the highest pleasure and satisfaction that I take the auspicious occasion of its union with the "Engineering Record" to speak a word of praise in its behalf and of hope and faith in its greater achievement in the future.

The "Engineering News" has always maintained a strictly independent, unprejudiced, high-minded and scientific attitude toward the engineering profession and the interests of the country at large as related to or affected by matters of engineering interest.

Having been only an occasional reader of the "Engineering Record," I lack the intimate knowledge from which to speak the praise which is given to the "Engineering News," but I believe that the "Record" has always maintained a high position among technical publications. It has striven earnestly toward the development of a high degree of excellence, and I know that it is a worthy companion and co-worker of "Engineering News."

The particular feature of greatest interest in this union of the two chief agents in this country for engineering publicity is their potential force to further the interests of the engineering profession and to help the country to use and profit by engineering service. The step forward which has thus been taken merits the most loyal support and best wishes of all engineers in America.

HUNTER McDONALD

Past President, American Society of Civil Engineers; Chief Engineer, N., C. & St. L. Ry., Nashville, Tenn.

In the consolidation of the two leading engineering journals of this country the responsible persons have voluntarily assumed an obligation and at the same time created an opportunity. The obligation is that, having eliminated that incentive for excellence and leadership which usually obtains as a result of competition, their plain duty is to see to it that the influence and energy of the consolidated papers are devoted to the engineering profession and not dominated by commercial considerations. The opportunity is the increased ability to reach a clientele of the highest class, composed of engineers and those usually allied with them, and to lead the way toward unity of effort on the part of all who are interested in seeing the establishment of correct engineering principles and practice in public as well as private matters, where such questions are involved. You can render a great service to the country and to the profession, and your course in this respect will determine largely whether new applicants for public favor will not be born of this merger.

JOHN R. MacARTHUR

President, MacArthur Bros. Co., Contractors, New York City

One of the earliest recollections I have of technical magazines is of "Engineering News," of which I believe we have a complete file since its inception. I know that from the beginning it took rank as the best expression of careful engineering thought and data, and it has always maintained this standard.

With a desire to be generous and yet frank to both journals, I will say that on the appearance of the "Engineering Record" everybody soon saw that a close and energetic rival to the "Engineering News" had come upon the field, and it, likewise, soon made itself indispensable.

We have greatly appreciated the value of both magazines during their entire history. I confess that I wonder whether in the consolidation we will lose or gain, for it is difficult to see how more can be done for the profession than has been done by the two journals separately in the past. At all events. I congratulate each of the journals in securing the intimate co-operation of the other, and we will look forward with great pleasure to your married career.

H. ELTINGE BREED

First Deputy Commissioner, New York State Highway Commission, Albany, N. Y.

"Engineering News" and the "Engineering Record" have hitherto appealed to somewhat different classes of the engineering world. The former has seemed to me to speak to the engineering expert and to the contractor with engineering skill; the latter, to the less scientific engineer, to the average contractor and to the interested layman. The closer the association among all of these people the more they will profit through interchange of ideas. The consolidation of the two magazines should mean greater consolidation of all engineering interests through giving them one strong organ of expression that will represent all classes. This will help the profession as a whole; and for us individually it will save time and energy, because we shall glean our current information from a single source.

JOSE R. VILLALON

Secretary, Department of Public Works, Havana, Cuba

I believe that the consolidation of the two great American engineering papers, the "News" and the "Record," will be of positive advantage to engineers and contractors. Duplications will be avoided and the presentation of special and important technical subjects considerably increased and improved under one cover. It is a very efficient step. I avail myself of this opportunity to wish you even greater success than heretofore.

FRANK C. OSBORN

Consulting Engineer, Cleveland, Ohio

The consolidation of "Engineering News" and "Engineering Record" should prove an excellent thing for the readers as well as for the owners and advertisers. In the past these journals have been an education in themselves, and the new journal should be of greater value than the two former ones were as separate publications. The economies effected by the consolidation should enable the owners to provide, and they doubtless will provide, an engineering journal without a peer, and one that no progressive engineer can afford to be without.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Ford Automobile, Single-Handed, Salves Sunken Driver Barge

By WILLIAM G. BROADHURST

F. R. Long-W. G. Broadhurst Company, Hackensack, N. J.

A FLOATING piledriver machine that had sunk in the Passaic River was recently pulled around to a level position and then pumped out and floated with the tide by a Ford touring car.

The driver, mounted on a hull 22 x 45 ft., 5 ft. deep, was sunk by being caught under a bridge fender at low tide and filling when the tide came over the deck, there being no watchman on duty at the time. The tide at this point rises and falls about 5 ft. The depth of water and the slope of the bottom were such that at low tide the forward end of the deck was 6 in. above water and the after end 18 in. below. It was found that if the after end could be pulled around about 90° toward the shore, the entire deck would be above water at low tide. Since the side and bottom were tight, the hull could be pumped out in this position and the machine floated. The deck, however, was not tight and had several holes and hatches that would be very difficult to make tight.

Early in the morning a Ford touring car was loaded with ropes and blocks, cable, canvas, oakum and tools and proceeded with four passengers to the scene of the trouble. High tide was at 10 a.m., and before that time a $\frac{5}{8}$-in. wire-rope sling had been passed twice around the stern of the hull and a $1\frac{1}{4}$-in. manila-rope tackle, rigged between the sling and the shore. A seven-part tackle of $\frac{1}{2}$-in. manila rope was luffed to the hauling part of the $1\frac{1}{4}$-in. tackle and the hauling part of this light tackle led to the rear axle of the touring car. The car was then run up and backed down on a convenient street, the $\frac{1}{2}$-in. tackle being overhauled each time. In about 20 min. the barge had been dragged around to the required position.

Low water was due at 4 p.m., and it was planned to pump out the hull with a 4-in. centrifugal pump belt driven by a 6-hp. gasoline engine placed on a float moored alongside the piledriver. Unfortunately, the starting crank of the gasoline engine could not be found, and as the weather was cold, the engine could not be started. However, if the crank was missing, the Ford was not. One back wheel was jacked up, the other wheels blocked, the fender removed and a belt run from the free wheel to the pulley of the balky engine. The automobile engine was started, and the driver sat at the wheel and cranked the balky 6-hp. engine for about 15 min. but without avail.

As the time of low water was rapidly approaching, it was decided to run the pump by means of the car. Skids were laid, the car backed down over the steep river bank at an angle of about 40° and run out on the float. The back wheel was again jacked up and belted to the pulley of the pump, whose suction hose was put through a hatch in the deck of the driver boat. The wheels of the car were blocked, and the rear axle was braced against the pump skids. The engine started without difficulty and was able to pump a full stream on low speed, although the load was too much for it on high speed. Plenty of oil was put in the automobile engine, and it was necessary for a man to pour water continuously into the radiator. The driver sat at the steering wheel with his foot on the low-gear pedal for 40 min., during which time the engine never balked and the piledriver was pumped out and floated. After everything was made safe for the night and two men were left on board to see that nothing happened, the car was run ashore, loaded up and with five men went bravely home again, none the worse for her strenuous day.

FOR the benefit of "Engineering News" readers it is well to explain that "Hints for the Contractor," which have been appearing in the "Engineering Record" for several years, will become a regular feature of "Engineering News-Record."

IN this section we aim to publish short illustrated articles describing interesting details of construction work. To do this we must depend to a large extent upon the co-operation of our readers. We want you to contribute to this section and shall, of course, pay you for your story when it is published in

HINTS FOR THE CONTRACTOR

Radial Bracing Supported by Center Pile Holds Large Steel Dam

By GLEN M. WILEY

Superintendent, Fred. R. Jones Co., Mahoningtown, Penn.

IN CONSTRUCTING a steel sheet-pile cofferdam 46 ft. in diameter for the Pennsylvania R.R. it seemed desirable to use a quantity of 8 x 16-in. 18-ft. timber, which was on hand, for bracing. As the distance across the cofferdam was more than twice the length of the timber, a wood pile was driven in the center of the cofferdam before excavating; and a "hub" supported by this pile was

SHORT TIMBERS UTILIZED BY SCHEME OF RADIAL BRACING FOR COFFERDAM

constructed as shown in the photograph. Excavation has been carried 18 ft. below water level, and two sets of waling and struts have been placed in this manner. The method has been very successful, and no trouble whatever has been experienced.

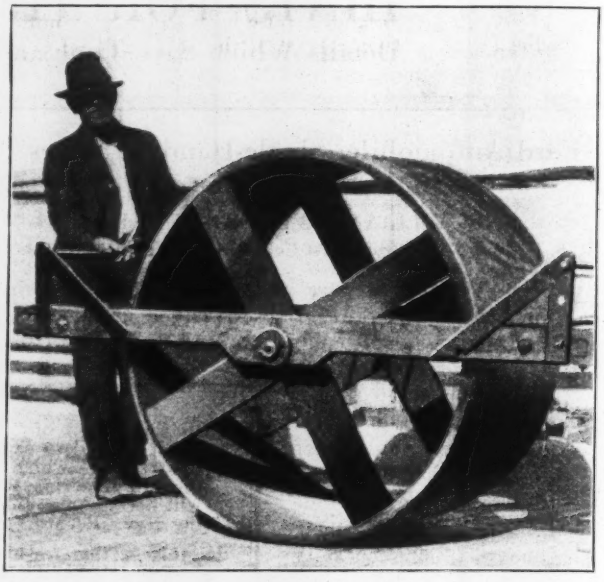
The work is being done for the Pennsylvania R.R. by the Fred R. Jones Co., of Chicago, for which the writer is in charge.

Machinery Made from Odds and Ends on Job Paves Top of Kensico Dam

By RICHARD R. BRADBURY
East Pleasantville, N. Y.

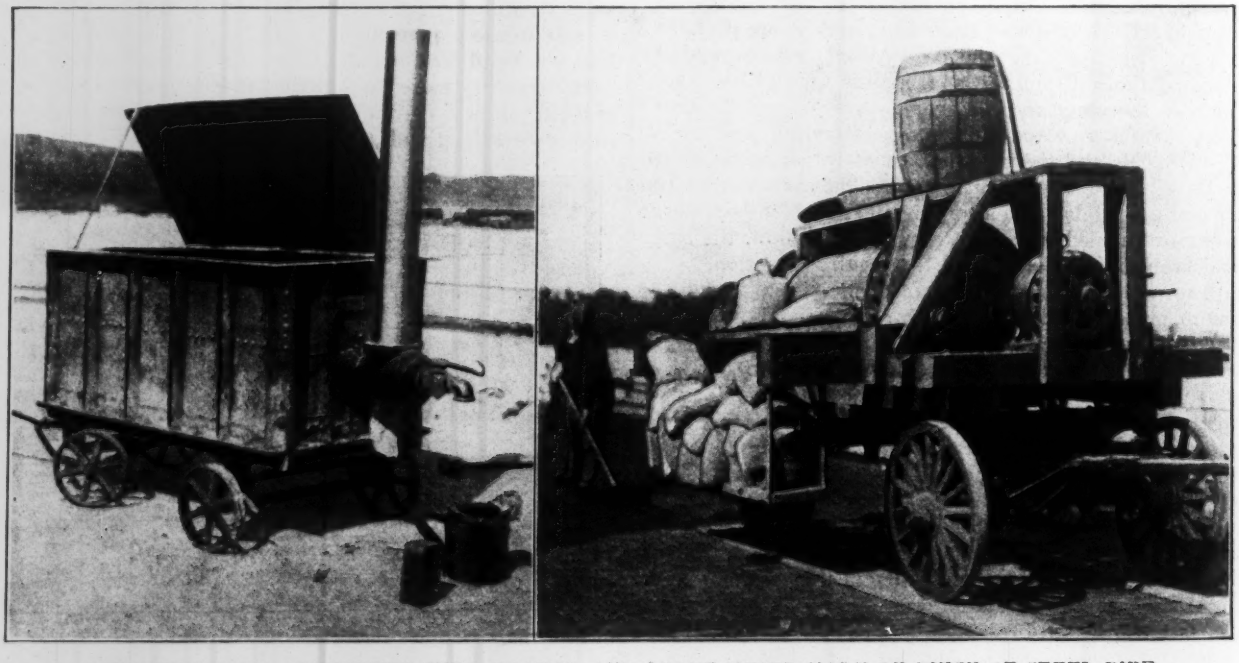
A COMPLETE paving outfit, some of which is shown in the photographs, was built out of material on hand at the Kensico dam by George H. Angel, superintendent for the contractor (H. S. Kerbaugh, Inc.) for building the brick roadway across the top of the dam. This road, which is level, is 21 ft. wide and about 2500 ft. in length. It is of semi-monolithic construction, the brick being set in a dry 1 to 3 cement mortar cushion laid on a concrete base. There is a concrete sidewalk on one side and a concrete curb on the other, each about 7½ in. above the surface of the roadway gutters. A heavy wood board shod with iron and mounted on wheels running on this curb and the sidewalk was used to screed the cement cushion, which was mixed dry in an ordinary concrete mixer, transported and dumped in piles by a locomotive crane and spread by hand. The first time over, 1-in. strips were placed under the wheels, after which the mortar was rolled by hand and again screeded to grade. The bricks were then laid, wet down, rolled with a large roller and grouted. Finally, the expansion joints were poured, using a portable heater.

The screed, made from old plate, wheels and plank on hand, was arranged so that, in addition to running it on the 1-in. strips, its height could be adjusted by a long bolt and nut at each end. The four wheels were placed in tandem, two at each end. The small roller was made by fitting an old belt pulley with a wrought-iron handle, while the large one was cut from a piece of 48-in. cast iron pipe. Wrought-iron spokes were fitted in this pipe, which was provided with a steel axle and two wood pulling bars counterbalanced by weight racks. The mixer for the wet grout was made by riveting flanges to the ends of a short length of 36-in. riveted steel pipe and bolting cover plates to them. An axle with paddles ran through the center and was turned by a small motor on one end. This machine was mounted on an old wagon body.



OLD PULLEY MAKES LIGHT ROLLER

The asphalt heater was made out of an old steel form that had been used for casting concrete blocks. This was



CONCRETE FORM CONVERTED INTO HEATER AND GROUT MIXER MADE OF PIECE OF STEEL PIPE

accomplished by riveting in a false bottom near the middle of the form, cutting a door in the lower half at one end and riveting on a hinged cover and a smoke-stack. A wood fire was built in the lower half underneath the false bottom and the asphalt placed in the upper half. The pipe for running off the melted asphalt was passed through the smoke-stack to keep it warm. This machine, too, was mounted on wheels.

Tie and Rail Sections of Portable Track Go Together Without Spikes

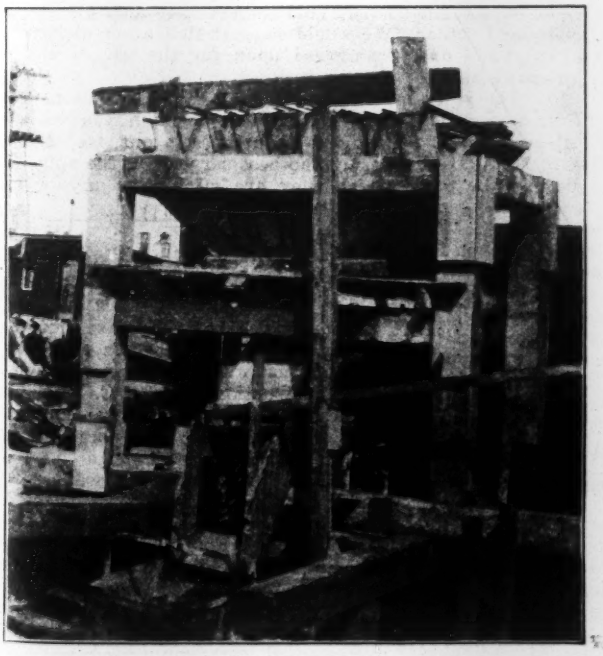
A SIMPLE form of portable track recently made use of by contractors in Southern California is reported by D. G. Bevis. Ties of 2 x 6-in. pieces, giving a broad bearing surface, are spaced as near together as necessary to support the load according to the soil, and held in place by 1 x 2-in. strips laid longitudinally on the outside of the flange of the rails, with a clearance of $\frac{1}{4}$ to $\frac{1}{2}$ in. The rails, made up in sections the same length as the tie sections, are tied together with $\frac{5}{8}$-in. rods put through a $\frac{3}{4}$-in. pipe spacer. The sections of rails in 15-ft. lengths, made to any gage desired from relay rails sawed in half, can be assembled in any machine shop. They are light enough to be handled quickly on the job and in shipping.

Rails Over Hopper Screen Out Boulders and Break Lumps on Sewer Contract

By H. W. STREULI
New York City

THE MATERIAL excavated from a section of the Passaic Valley sewer contained many fair-sized boulders running up to $\frac{1}{3}$ cu.yd. each, besides heavy wet sand, clay and gravel. Excavated by a 10-ton locomotive crane handling a $\frac{3}{4}$-yd. Williams clamshell bucket, the material was dumped into a wooden bin of about 4 or 5 yd. capacity. This bin was used to load dump buckets, which were handled by derricks to a spoil bank out of reach of the crane. The discharge hopper of the bin frequently became clogged with boulders and large chunks of conglomerate, and although a man was placed on the top of the bin with a rod to break up the larger lumps, delays still occurred on account of the clogging.

To avoid the necessity of building a larger bin and chute, which would have entailed other difficulties, old 30-lb. rails were fastened to the top of the bin about 15 in. apart and at an angle with the horizontal. The impact of the material falling from the clamshell bucket broke up the large pieces of clay and separated those boulders which were too large to pass through the discharge chute.

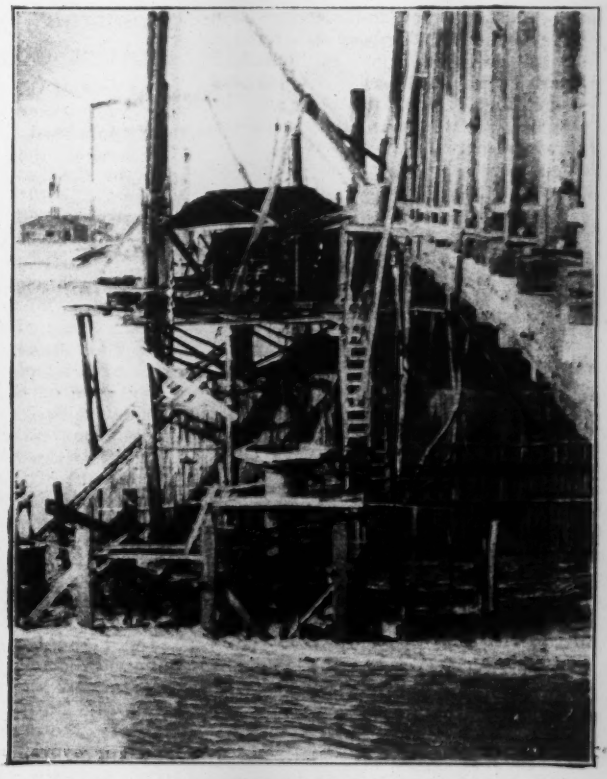


RAIL SCREEN BREAKS LUMPS AND REMOVES BOULDERS

Close Bottom Door of Concrete Lock with Hoist Line

By C. H. HOLLINGSWORTH
Consulting and Construction Engineer, St. John, N. B.

IN CONCRETING the caisson working chambers on the bridge construction at Moncton, N. B., the bottom door of the concrete lock was closed by the hoisting engine. This was a three-drum engine. Two lines were used to handle the derrick, which received concrete from the cableway in buckets and dumped it into a hopper erected over the concrete lock. A line from the third drum, led through the lock in the same way as had been the bucket line used in sinking, and attached to the bottom door, was used to raise this door and help hold it shut while the concrete was dumped, being slacked off to drop the door when the concrete was locked in.



DOOR OF CONCRETE LOCK CLOSED BY HOIST

NEWS OF THE WEEK

Current Events in the Civil Engineering and Contracting Fields

Engineer Organizations Aid Preparedness Movement

National, State and City Societies Report Action Taken in Anticipation of War

Short of actual participation with the War Department, the engineers of the country are showing that they are behind the President in whatever move may be forced by the fast-approaching crisis. With hardly an exception those engineering organizations which are constituted in such a way that definite action has been possible, have passed resolutions setting forth their loyalty and have named committees to classify the resources of men, skill and materials in the field and vicinities covered by them. In many instances this work has been under way for some time; but the events of the last few weeks have lent a new impetus to the efforts, and it is not an exaggeration to say that, if war came now, the technical resources would not be found unorganized.

As the result of a recent inquiry "Engineering News-Record" is able to present the following resume of the activities of engineering societies in national defense:

Contractors' Offer Without Reservation

The action of the General Contractors' Association at the meeting held Feb. 6 indicates the general feeling, and its communication to President Wilson could hardly be equaled for brevity and generosity. Signed by Frederick J. MacIsaac, the president, the telegram reads as follows:

To His Excellency, the President of the United States.

Sir—At a meeting of the Executive Committee of the General Contractors' Association of the State of New York, held at the Engineers Club in the City of New York, on the sixth day of February, it was

Resolved, That the members of this association tender to you the services of their organization and equipment, as may be required to meet any conditions which may arise, in the defense of the honor and integrity of our country.

As a result of this communication the War Department requested the association to assist in preparing an inventory of labor, contractors' plants and equipment that might be available for Government purposes. This work has just been finished. On Monday, Apr. 2, the General Contractors' Association announced that it would undertake at actual cost plus 7½%, this added percentage to cover the use of small tools, field supervision and insurance, any work desired by the War Department.

Other Organizations Urge Action

The American Institute of Consulting Engineers recently telegraphed the following as an expression of its attitude in the present crisis.

(Continued on Page 62)

General Goethals Retained by New Jersey

Gen. George W. Goethals has been retained in a consulting capacity to the highway department of New Jersey. Legislation just enacted creates the position of state engineer and provides that the duties of that office shall be to act as adviser to and supervisor of the state highway department, to act in a similar capacity for any commission created to construct tunnels under the Hudson River or bridges or tunnels over or under the Delaware River, and to supervise any work undertaken by a commission charged with the development of the Port of New York, or any other port within the state.

In General Goethal's connection with the highway department, he will be responsible for its proper organization and development and will generally supervise plans and specifications and also pass upon materials of construction.

A law has just been enacted raising a fund of $15,000,000 to be expended on highway improvement in the next five years at the rate of $3,000,000 per year. The work will be in charge of a commission of eight members serving without pay.

Reservoir Roof Collapses After 7 Years' Service

The roof of the 13 million gallon Wilson Ave. water reservoir, Pasadena, Calif., collapsed on Mar. 25, 1917. The city bought the reservoir and other plant of the Lake Vineyard Land and Water Co. in 1912, the company having built the reservoir in 1910. The reservoir is 414 x 283 ft., 17 ft. deep, excavated in earth on 1:1 slopes, and has a concrete lining. The roof was 1-in. boarding on joists on girders, the post spacing being about 16 ft. The posts were 2-in. standard-weight pipe. The edges of the roof rested on a sill on the upper edge of the concrete lining. It is believed that this sill slipped off its bearing on one side of the reservoir and pushed the roof structure over. A full account of the accident will appear in an early issue of "Engineering News-Record."

Idaho Licenses Architects, But Not Civil Engineers

The Idaho Legislature has passed a bill creating a state board of examiners of architects and prescribing and regulating the duties thereof. Idaho now regulates the practice of architects and land surveyors, but places no restrictions upon the practice of civil engineering.

New York Contractors Offer War Services at Cost

Would Undertake Military Construction with Their Own Resources and No Profit

Stating that its members would waive all profit, the General Contractors' Association, at New York City, through its president, Frederick J. MacIsaac, has sent a letter to Col. Frederic V. Abbott, in command of the coast defenses of New York and the immediate vicinity, which reads in part, as follows:

"Referring to our recent conversation in regard to placing at the disposal of the War Department the men and equipment of the General Contractors' Association, we beg to advise you as follows: The General Contractors' Association of New York is composed virtually of all the large contractors within the metropolitan district. We offer our services to the Government and have appointed a committee of members in different lines of work so that you can get in touch with the association and its members quickly to perform any kind of work you may need.

"We are prepared to undertake the construction of trenches and underground work in connection therewith, tunnels, railroads, foundations, embankments, docks, bridges, roads and camps. We will supply men and materials for your work at actual cost, plus 7½%; this added percentage to cover the use of small tools which we have on hand, field supervision and insurance. We would suggest that a per diem rate be agreed upon for the use of equipment.

"In making this proposition to the War Department through you we are doing so with the sole purpose of rendering the best services in the spirit in which they are offered at any or all times."

M. I. T. Instruction Committee Headed by Dr. Mann

The president of the Massachusetts Institute of Technology has appointed a faculty committee on improved methods of instruction, and Dr. C. R. Mann, of the University of Chicago, Department of Physics, has been added to the institute's faculty as chairman of this committee. Dr. Mann, who will devote his entire time to the work, for three years has been the special investigator of the Carnegie Foundation in its recent study of the teaching of engineering in American schools. One of the efforts of the committee will be an attempt to solve the problems of preventing an overcrowded curriculum and securing the proper training of instructors.

"Engineering News-Record" Editorial Staff

Editors from Staffs of Separate Journals Who Will Conduct the Consolidated Journal

The editorial staff of "Engineering News-Record" will be made up of the following men:

CHARLES WHITING BAKER
Editor-in-Chief

Charles Whiting Baker graduated from the civil engineering course of the University of Vermont in 1886. As a result of some contributions which he had furnished to "Engineering News" while still an undergraduate, he was offered by George H. Frost, the publisher, a position on that paper after graduation, but had at the time already accepted a place with the Baldwin Locomotive Works in Philadelphia. Six months later the offer from "Engineering News" was repeated and accepted. In 1895, at the death of A. M. Wellington, Mr. Baker succeeded him as Editor. He became also a director in and Secretary of the Engineering News Publishing Co., continuing in these latter positions until the divided ownership of the paper was ended by the repurchase of outside interests by Mr. Frost in 1909.

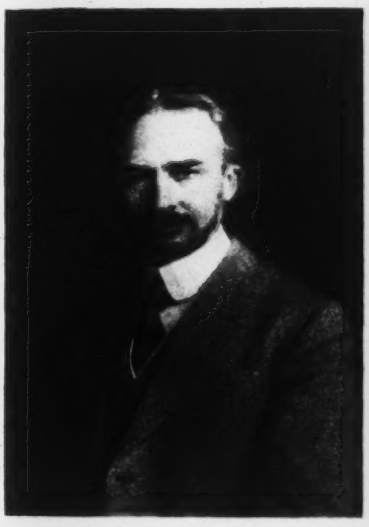
Very early in his editorial work, Mr. Baker became interested in economic questions, and published in 1899 a book entitled "Monopolies and the People," which ran through several editions and was revised ten years later. He became a member of the American Society of Mechanical Engineers in 1893, and was a Vice President of the Society from 1909 to 1911. In 1913 he was appointed by the Governors of New York and New Jersey a member of the Palisades Interstate Park Commission and was recently reappointed for a second five-year term. He is Chairman of the Committee in charge of the construction of the Henry Hudson drive, a scenic roadway under the Palisades, the first section of which will be opened this year. Mr. Baker has been a resident of Montclair, N. J., since 1888.

M. N. BAKER
Editor

M. N. Baker studied engineering at the University of Vermont, graduating in 1886. He began contributing to technical journals during his senior year at college. Following his graduation he was engaged in the bridge and building department of the Union Pacific R.R. at Pocatello, Idaho, for a time, and later was engaged in architectural work at Fitchburg, Mass. In the fall of 1887 he joined the editorial staff of "Engineering News," and immediately took up special work in the field of municipal and sanitary engineering. He edited "The Manual of American Water-Works," which was published by "Engineering News" for the years 1888, 1889-90, 1891 and 1897. He also edited another and somewhat similar publication of broader scope, "The Municipal Year-Book," which was published in 1902.

His intimate acquaintance with the rapid progress in the fields of water purification, sewage treatment and garbage disposal in the early '90's was shown by a series of articles on each subject printed in "Engineering News." One of these was reprinted in 1893 as "Sewage Purification in America." In the following year he joined with the late George W. Rafter in producing a monumental treatise on "Sewage Disposal in the United States." Among other books from his pen that soon appeared were "Potable Water," "Municipal Monopolies" (section on Water-Works) and "Municipal Engineering and Sanitation." In 1904, following a tour abroad, he published a book on "British Sewage Works," and a collection of articles on "British Refuse Destructors."

Editor-in-Chief of "Engineering News-Record"



CHARLES WHITING BAKER

In 1889 he made his residence in Montclair, N. J., and took an active part in public affairs. He was elected a member of the township committee in 1893 and in 1894 was appointed a member of the Montclair Board of Health, serving on the board for twenty years, during the last ten of which he was its president. During this period he made the town of Montclair known among sanitarians the world over for its progressive health work, particularly in the sanitary control of the milk supply.

He resigned his position on the local Board of Health in 1915, when he was appointed by Governor Fielder a member of the New Jersey State Board of Health, and he was elected Vice President of the board and Chairman of the Bureau of Engineering.

He has long been an active member of various societies devoted to municipal engineering and administration, such as the American Water-Works Association, the New England Water-Works Association, the American Public Health Association, and the National Municipal League. He has been President of the New Jersey Sanitary Association, Vice-President of the New England Water-Works Association, and is Chairman of the Executive Committee of the National Municipal League. He served for a number of years as Special Agent of the United States Bureau of the Census and has contributed articles on a wide range of municipal subjects to "The International Encyclopedia," "Nelson's Encyclopedia" and the "International Year-Book."

ROBERT K. TOMLIN, JR.
Managing Editor

Robert K. Tomlin, Jr., was graduated from Harvard University with the degree of B. S. in Civil Engineering in 1907. During his college course, he served for two summers as assistant to Prof. Hector J. Hughes in surveying and railroad field work at the Harvard Engineering Camp, Squam Lake, N. H. His next work was in the compressed-air tunnels of the Pennsylvania Railroad under the East River, New York City, and in the open air cross-town tunnels leading to the Pennsylvania Terminal. He resigned this position to join the staff of the Catskill Aqueduct where, under Robert Ridgway, he served in the executive division of the Northern Aqueduct Department of the New York Board of Water Supply at Poughkeepsie, N. Y. In March, 1909, he became assistant to the editor of the "Engineering Record." Later he was made associate editor, in charge of the municipal and sanitary engineering fields, and in 1913 was promoted to the managing editorship of that journal.

FRANK C. WIGHT
Associate Managing Editor

Frank C. Wight is a native of Washington, D. C. He studied at Columbian (now George Washington) University and later at Cornell University, where he graduated with the degree of Civil Engineer in 1904. Before entering college he spent three years as assistant in the Library of Congress, and during his summer vacations was employed in the Surveyor's Office of the District of Columbia. Following his graduation he was for three years in the office of the Engineer of Bridges of the District of Columbia engaged on the design and construction of numerous bridges in Washington and vicinity. He was field assistant in the construction of the $1,000,000 Connecticut Ave. concrete bridge, and was masonry designer and assistant resident engineer on the $500,000 steel bridge at Anacostia across the eastern branch of the Potomac. He became a member of the editorial staff of "Engineering News" in December, 1906, and was made Managing Editor in 1912. Mr. Wight is the author of the annual review of civil engineering progress, published in the American Year-Book for the past six years. He has specialized in concrete construction and has taken an

active part in the work of the American Society for Testing Materials and the American Concrete Institute.

E. E. R. TRATMAN
Western Editor

E. E. R. Tratman was born in Bristol, England. He spent three years in London with Edward Wilson, railway and consulting engineer and representative of various foreign railways. He came to the United States in 1884, and was for a time in the engineering department of the Long Island R.R., and later was engaged on building work.

He began work for "Engineering News" in 1886 and specialized in the field of railway work. He is the author of a treatise on railway track and track work of which numerous editions have been printed and which is recognized as the standard work in the field.

In 1888-90 and 1894 he was special agent of the U. S. Department of Agriculture, to investigate metal and wood ties and the preservation of ties. In 1888 he received the Norman Medal of the American Society of Civil Engineers for a paper on "English Railway Track." In 1890 he investigated for New York parties the use of portable railway track and equipment for construction work and light railways in foreign countries. Since 1903 Mr. Tratman has been located at the Chicago office of "Engineering News."

Mr. Tratman is a charter member of the American Railway Engineering Association, and has served on its Yards and Terminal Committee for some years. He is an Associate Member of the American Society of Civil Engineers, and a member of the American Institute of Mining Engineers, the Western Society of Engineers, the Roadmasters' Association and the International Tramways Association (of Europe). He has been for a number of years Secretary of the Illinois Society of Engineers.

FREDERICK E. SCHMITT
Associate Editor

Frederick E. Schmitt had an early training in mechanical engineering work in a Wisconsin machine shop and drafting room. He then turned by preference to civil engineering and was graduated from that course at the University of Wisconsin in 1900. After two years with the Berlin Iron Bridge Co. and its successor the American Bridge Co., he joined the editorial staff of "Engineering News." His work there, in the field of structural engineering especially, has made him widely known in the profession. He carried on some years ago an extended experimental investigation of the rigidity and oscillation of tall buildings. A study of traffic speed and capacity of rapid-transit railways gained him the degree of Civil Engineer from his University.

In connection with the fall of the first Quebec bridge in 1907, which he investigated and reported upon for "Engineering News," he took an active part in agitating for a thorough study of compression members. He is a member of the American Society of Mechanical Engineers and of the American Society for Testing Materials. When the latter society conducted the 1912 congress of the International Association for Testing Materials, he participated in the organizing work and as chairman of the papers committee developed the technical program of the congress.

W. W. DE BERARD
Western Editor

W. W. De Berard became Western Editor of the "Engineering Record" in 1911, following nine years' practical experience in all phases of sanitary engineering, including the design, construction and operation of filtration plants. Several of these years were spent on special filtration experiments at the Philadelphia Testing Station, at Harrisburg, Penn., and at Oakland, Calif. At the latter place he inaugurated the first experiments on water filtration on the Pacific Coast, which were expected at that time to lead to the construction of filters larger in capacity than any yet constructed. Financial difficulties intervened, however, to prevent the work being carried out.

Mr. De Berard graduated from Beloit College in 1896 and became chemist and bacteriologist for the Denver Union Water Co., building the first water laboratory west of Chicago. He later went to the Massachusetts Institute of Technology and after his graduation in 1901 he started in the engineer's nomadic quest for experience, working less than two years in a place. He filled positions with water departments at Philadelphia, Harrisburg, Columbus, both water and sewage plants, Oakland and Denver. He was also with the U. S. Reclamation Service on the Sacramento Valley investigations. He was on the staff of New York City's Metropolitan Sewage Commission just before he accepted the position with the "Engineering Record."

HENRY D. HAMMOND
Associate Editor

Henry D. Hammond studied for two years at Vanderbilt University, Nashville, Tenn., and later at the Sheffield Scientific School, Yale University, where he graduated with the degree of Ph.B. in 1908. He received his B.A. degree the following year, during which he served as instructor in field surveying. In August, 1909, he began work as material clerk on the foundations of the Municipal Building, New York City, for The Foundation Co., where, except for a few months with the American Bridge Co., he remained until 1914. His work included several pneumatic-caisson drop shafts, abutments for the Kaw River bridge, Kansas City, Mo., several buildings in St. Louis, a bridge in Ohio and the foundation work for the Western Union Building and for the Astor Building, New York City. He has been successively blacksmith's helper, pipefitter, labor foreman, carpenter foreman, timekeeper, night superintendent, section engineer, walking boss, and assistant superintendent on construction work of various kinds. After serving on Ohio River Dam 19, Mr. Hammond joined the editorial staff of the "Engineering Record" in 1915. His work on the journal was principally in the field of construction. He has been responsible for the "Hints for the Contractor" section of the paper, for the monthly prices of engineering materials, and the weekly review of construction activities.

HARRY BARKER
Associate Editor

Harry Barker graduated from the electrical engineering course at the University of Vermont in 1904. During the succeeding year he was principal assistant to W. H. Freedman, Consulting Engineer of Burlington, Vt., engaged in mechanical and electrical design, testing, etc. At the same time he was instructor in electrical engineering at the University. For a year and a half following he was engaged on various work in the West concluding with hydraulic field work for the Nevada Consolidated Copper Co.'s Ely and Steptoe development.

Early in 1907 he joined the editorial staff of "Engineering News" and has been specially active in the fields of hydraulic and mechanical engineering. He is the author of a treatise entitled "Public Utility Rates," which has just been published by the McGraw-Hill Book Co. Mr. Barker is a member of the American Institute of Electrical Engineers and has recently been commissioned a Captain in the Engineer Reserve Corps of the U. S. Army.

C. W. STARK
Associate Editor

C. W. Stark graduated from Harvard University in 1903 and entered railroad work the same summer as assistant on the engineer corps in the maintenance-of-way department of the Baltimore & Ohio R.R., being stationed at Chicago. He left this work after a year and a half, and entered the engineering department of the New York Central railroad. A large part of his 5½ years with this road was spent in the office of engineer of grade crossings, where he was successively draftsman, assistant engineer and assistant to the engineer of grade crossings. Besides having all grade-crossing work outside of the New York district, this office at that time handled all negotiations relative to the extensive changes—bridges and relocations—necessitated by the New York Barge Canal.

Mr. Stark's last year with the New York Central was spent in the general designing department, where he was occupied mainly with yard design and preliminary studies and estimates for extensive projects. He left the New York Central in 1911, and subsequently spent a year with the Central Railroad of New Jersey, where, among other things, he had to do with the track

layouts of the reconstructed passenger and freight terminals at Jersey City. He came to the editorial staff of the "Engineering Record" in November, 1912, and has been specially active in the fields of rail and water transportation.

MONT SCHUYLER
Associate Editor

Mont Schuyler was graduated from Washington University in 1905, with the degree of B.S. in Civil Engineering. He was assistant engineer, connected with the distribution system and, later, with the supply and purifying division of the St. Louis Water Department until 1908, when he was made engineer in charge of the Municipal Testing Laboratory of St. Louis. In this position, he directed the technical examination of supplies and materials of construction, conducted research on pavement types, concrete, drain tile, etc.; wrote specifications, principally for materials and methods used in paving; designed laboratory apparatus and developed methods of testing. He became connected with the American Rolling Mill Co. in February, 1916, and was with the Emerson Electric Manufacturing Co. from July to December, 1916, perfecting a mechanical household refrigerator. Mr. Schuyler joined the editorial staff of the "Engineering Record" in January of this year.

N. A. BOWERS
Pacific Coast Editor

Nathan A. Bowers is a graduate of Rose Polytechnic Institute and joined the staff of the "Engineering Record" in 1910. He devoted most of his time to articles in the hydro-electric field. When the "Engineering Record," several years ago established an office in San Francisco, Mr. Bowers was selected for the post of Pacific Coast Editor. In this capacity he has served not only the "Engineering Record" but the other McGraw engineering publications, notably the "Electrical World," the "Electric Railway Journal" and "Metallurgical and Chemical Engineering."

Hell Gate Bridge Is Opened for Traffic

Traffic over the Hell Gate Bridge and the New York Connecting R.R. in New York City was inaugurated Apr. 1, when the Federal Express, from Washington to Boston via the Pennsylvania and the New York, New Haven & Hartford railroads, was restored to service. In former years this train was ferried through the East River between Jersey City and Port Morris, about 20 miles. Because of the strong tidal currents and the increasing traffic in the river the operation of the train was discontinued several years ago. Its restoration will be followed by the putting on of other through trains. Freight traffic will later use the bridge, ferrying across New York Bay, when the Bay Ridge line is completed.

New Method Used in Omaha Bridge Rolling

Timber Towers, Erected on Rolling Shoes, Carry Spans—Track on Ground, Not on Piers

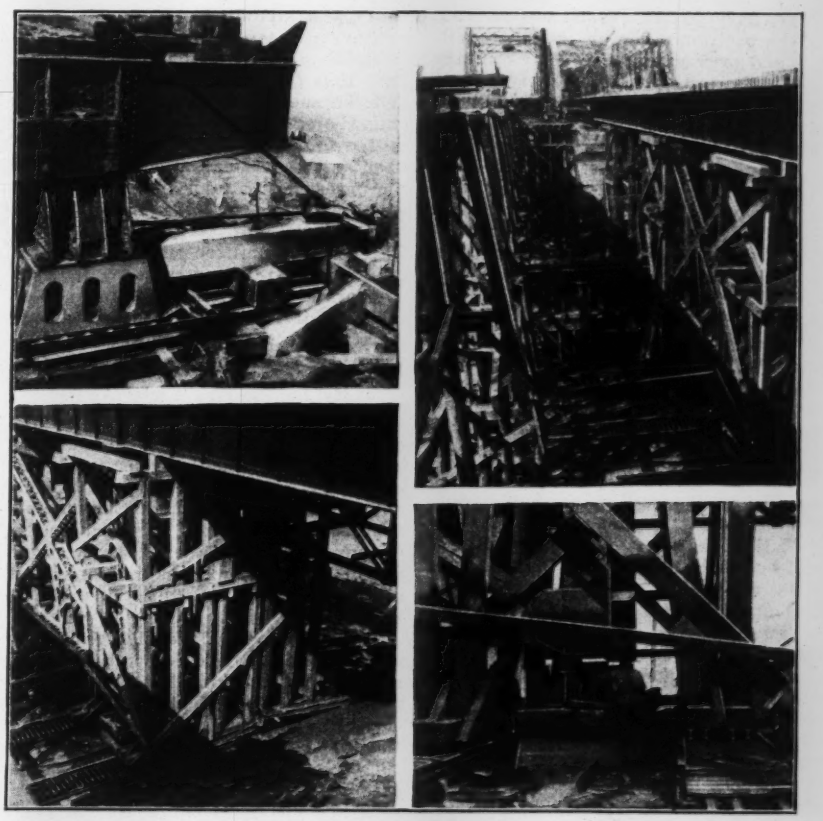
Replacing the five east end spans of the Union Pacific System bridge across the Missouri River at Omaha was done in novel manner, using the rolling method, on Mar. 22. The moving of the four main spans (of 246 ft. 3 in.), on Dec. 23, 1916, was described in "Engineering News," Jan. 18, 1917, and "Engineering Record," Jan. 6, 1917.

The five end spans comprise a riveted through-truss span of 121 ft. and four plate-girder spans 50 to 68 ft. long, replacing three truss spans. The steel tower supports were suspended from the spans and moved with them. The rolling track was laid on the ground, and timber towers erected on the rolling shoes carried the spans, as shown in the views herewith. This moving on towers made the job different from the ordinary rolling, where the track is laid on the bridge piers and the bridge shoes bear directly on it.

Rolling the truss span (adjoining the river bridge) was done separately from the moving of the plate-girder spans. The four plate-girder spans were pulled by five tackles, one at each support, handled by two locomotive cranes and two four-drum stationary engines. These spans were moved about 30 ft. in a moving time of only 8 min. The through span was moved by a single stationary engine, handling both leads. Its shift was 43 ft., which was accomplished in 4 min. actual moving time. The end clearances were very narrow, but no binding or interference took place.

The moving crew took over the bridge at 10:16 a.m., and traffic was resumed over the new bridge at 2:40 p.m.

The moving was handled by the American Bridge Co. forces under K. S. Strickland, erecting engineer, and T. S. Melton, superintendent. W. L. Brayton, bridge engineer of the Union Pacific, and C. A. Handeyside, assistant engineer, were present to represent the railway. Union Pacific trains were detoured over the Illinois Central bridge during the moving.



PULLING LINE HITCH AT ONE END OF SERIES OF SPANS
Falsework Towers on Roller Track Carrying the New Plate Girders

FOUR NEW PLATE GIRDERS MOVED WITH TOWER SUPPORTS
Lowering the Steel Tower Onto Its Shoe at End of Move

Pile Bents in Kaw River Bridge Approach Settle

The pile and timber trestle approach on the Missouri side of the new Wyandotte County bridge over the Kaw River at Kansas City, Mo., recently developed a slight settlement in a few of the pile bents. Street-car traffic was temporarily discontinued, but was soon resumed when the sagged portion was shimmed up. The new 23d St. trafficway will replace the temporary approach.

Engineer Organizations Aid Preparedness Movement

(Continued from Page 58)

To the President—The American Institute of Consulting Engineers, through its council, respectfully urges that effective protection of American lives and property on the high seas be provided immediately by arming our merchantmen and employing the naval forces of the United States to such an extent as may be necessary.

It is respectfully urged that you call Congress in special session at once in order that the country may be prepared to take immediate and effective action to meet the situation which confronts us and provide for all eventualities.

The American Society of Civil Engineers at its regular meeting on Mar. 7, and the Board of Directors of the American Institute of Mining Engineers, have passed resolutions backing up the position taken by President Wilson and urging that universal military service be initiated at as early a date as possible, in order to be prepared for just such crises as are at present before us.

The American Society for Testing Materials, through its 37 special committees which have an aggregate membership of 1017, can be made of immediate value to the Government as a nucleus in the organization and operation of a body of experts to look after the inspection and tests of materials in general. A resolution covering this has been prepared and will be presented to the executive committee of the society at its next quarterly meeting on Apr. 10.

To Prevent Injury to Water-Works

Leonard Metcalf, president of the American Water-Works Association, has informed "Engineering News-Record" that the question of preparedness will be taken up as one of the first subjects at the coming meeting of the Executive Board. The particular part of the field that this association will cover will undoubtedly be the maintenance of the home water-supply at the highest point of efficiency. There are few things so necessary to community life and so easily damaged as a water-supply system. Mr. Metcalf feels that it would be unwise to drain the operating corps of water departments for the purpose of active military ends, but that by conserving the health of the community and preventing malicious injury to supply systems the water-works engineer will be doing his fair share and more.

Automotive Engineers Get Ready

The Preparedness Committee of the Society of Automotive Engineers, consisting of President George W. Dunham, Past President W. H. Van Dervoort and Vice President Jesse D. Vincent, is not only making a classification of members with reference to their qualifications to co-operate with the Government, but is taking an active part in the plan which is under way to increase the membership of the society by probably one thousand during the next month. A very large membership is necessary in event of war, since the automotive industry will have the honor and duty of taking full responsibility for important activities on behalf of the Government in such an event.

The Motor Truck Club of America, through its president, Roderick Stephens, offered last week to move the equipment of the Seventy-First Infantry, New York, which has been called to duty.

Electrical Engineers Classify Membership

On Feb. 8 of this year the Executive Committee of the American Institute of Electrical Engineers issued a circular to its membership in the United States, together with a data sheet, with a view to tabulating the experience and availability of its members for military or naval service as officers or enlisted men. About 1800 members have thus far responded to this appeal, and the sheets continue to be received daily, being classified by a special committee for such use as may be decided upon as the national situation develops. The latest action taken by the institute was the appointment of a Committee on National Defense, at a meeting of the Executive Committee on Mar. 26. The functions of this committee will be to co-operate with similar committees of other societies and with the various departments of the Government when war is declared.

City Engineering Clubs Active

The engineers' clubs in the various cities by co-operating with national societies can probably render more efficient services than by taking independent action. The Engineers' Club of Baltimore has recognized this fact and is carrying out its share of the work of the Industrial Survey, having appointed a standing committee through which it will work.

With the idea of getting ready for any crisis that would demand concerted action among technical men, the Engineering Society of Buffalo has succeeded in affiliating into one big society the various technical activities, such as the chemists, electrochemists, mechanical engineers, automotive engineers, civil and electrical engineers. A committee, with David Howard in charge, has been appointed to keep in touch with any work that might be demanded by the Government. Still another committee, with A. L. Johnson as chairman, is looking into the question of holding classes for technical instruction along military lines, while a third committee, in charge of W. B. Powell, is taking a census of the special abilities of each member.

The engineers' clubs of Philadelphia and many other cities have tendered their services formally to the War Department or to the President; and while few of them have done any definite or constructive work, still undoubtedly everything is ready and awaiting only the word from Washington to undertake any branch of military or civil work that they may be called upon to do.

New York Engineers' Club Indorses Pledge

At the regular monthly meeting of the Board of Management of the Engineers' Club of New York City it was unanimously voted to indorse the sentiments of patriotism expressed by the following pledge, which is receiving wide general circulation:

As an American, faithful to American ideals of justice, liberty and humanity, and confident that the Government has exerted its most earnest effort to keep us at peace with the world, I hereby declare my absolute and unconditional loyalty to the Government of the United States and pledge my support to the President in protecting American rights against unlawful violence upon land and sea, in guarding the nation against possible attacks and in upholding international rights.

A copy of this was sent to each member of the club with the request that he sign and return it to the secretary.

Western Engineers Act

The Western Society of Engineers has taken an active interest in the work of military preparedness and has offered both the President and the Chief of Engineers, U. S. A., any assistance that may be practicable. The society was requested to circularize its membership relative to the Engineer Officers' Reserve Corps and has done so. It has also recently had two special meetings, which were addressed by army officers and by representatives of the Training Camps Association. Further, this society took an active part in the preparedness parade last year and also in a series of military lectures under the direction of a Joint Committee on Military Engineering. This committee is also conducting drills in which a large number of engineers are taking part.

The Engineers and Architects Club of Louisville is taking a very active part in aiding the present campaign of organization for national defense. The subject was first discussed at a regular meeting of the club about one year ago and took definite shape in September of last year, when a resolution was adopted offering the use of the clubrooms as a meeting place for a class of instruction in the subjects necessary to qualify its members and others interested, for admission to the Engineer Officers' Reserve Corps, authorized under the National Defense act of June 3, 1916.

In October a class was organized under the direction of Major George R. Spalding, of the Corps of Engineers, U. S. A. The class began with an enrollment of about 25 and has increased in members until its present enrollment is upward of 90. The instructions consist of lectures, quizzes and drills, both closed and open order.

Fifteen members thus far have taken the required examination, and five have been notified of their appointment to commissions in the Engineer Officers' Reserve Corps.

The Indiana Engineering Society, working in connection with the Indianapolis Engineers' Club, is taking a census of the state to determine the quali-

fications of the engineers for assisting in the national defense in case of war.

The society has also pledged support to the Government and is organizing an engineer battalion.

The growing importance of engineers in war is fully recognized by Government authorities. Every engineer, either through his local engineers' club or through the national society with which he is affiliated, can be of immense service to his country in some way or another. Those engineers who are not members of a local or national society should at the earliest possible moment offer their services to the Government through some such organization. Whether or not one believes that war is desirable, still in a crisis such as this, personal opinions should be set aside and everyone who has anything to offer should place it at the disposal of his country.

Personal Notes

C. C. Cunningham, roadmaster at Liberal, Kan., was appointed division engineer on the El Paso division of the Chicago, Rock Island & Pacific Ry. with headquarters at Dalhart, Tex. He is a graduate of Yale and has been with the engineering and maintenance-of-way departments of the railroad since 1909.

W. H. Armstrong and **Albert Haney**, civil engineers, Johnstown, Penn., have been appointed by the Marion County Court as advisory and consulting engineers for roadwork to be done this year. The court has named **J. R. Wilson** special road engineer for the Lincoln district.

C. C. Van Valkenburgh has been appointed city engineer and **Robert R. Fisher**, chief deputy city engineer, of Fresno, California.

Elisha Lee, assistant general manager of the Pennsylvania R.R. and better known as spokesman for the railroads in the controversies with the railway brotherhoods, has been promoted to be general manager, succeeding S. C. Long, deceased. Mr. Lee, a civil engineer, was born in Chicago in 1870 and was graduated from the Massachusetts Institute of Technology in 1892. The same year he entered the employ of the Pennsylvania R.R. as rodman in the office of the division engineer of the Tyrone division. He was promoted to assistant supervisor in 1899, to supervisor in 1901 and to assistant engineer in the maintenance-of-way department in 1903. In 1907 he was made principal assistant engineer of the Philadelphia, Baltimore & Washington R.R. Two years later, in 1909, he was transferred to the operating department as superintendent of the New York, Philadelphia & Norfolk R.R., both of these roads being part of the Pennsylvania system. He was then successively promoted to assistant to the general manager of the Pennsylvania, general superintendent of the Philadelphia, Baltimore & Washington and assistant general manager of the Pennsylvania R.R. This last advance was made a year ago.

Joseph Johnson, chief of the transit bureau of the Public Service Commission for the first district, New York, has resigned and will take up newspaper work.

James A. McQuade, general inspector, Public Service Commission for the first district, New York, has resigned and intends to join his brother in the brokerage business. **Frank K. Bowers**, of New York City, will take his place.

John A. de Windt, Jr., New York City, has been appointed chief of the transit bureau of the Public Service Commission, first district, New York, to take the place of Joseph Johnson, resigned.

L. C. Willis, recently city engineer and superintendent of water-works at Humboldt, Kan., has been appointed to a similar position at Altoona, Kansas.

O. R. Welch, formerly with Tuttle & Pike, consulting engineers, Kansas City, and more recently with the valuation division of the St. Louis & Santa Fe Ry., has been appointed city engineer of Fort Scott, Kansas.

E. N. Layfield, secretary of the Western Society of Engineers, has resigned to join the staff of W. F. M. Goss, president of the Railway Car Builders' Association.

H. A. Lane, assistant to the chief engineer of the Baltimore & Ohio R.R., has been appointed chief engineer, succeeding R. N. Begien, promoted. Mr. Lane was born in 1874 and was graduated from Tufts College in 1897. For two years he was in various engineering work for short periods. From 1899 to 1902 he was with the New York, New Haven & Hartford R.R., being successively transitman, assistant to resident engineer, and assistant engineer. He came to the Baltimore & Ohio in 1902. In 1908 he was made assistant to the chief engineer maintenance-of-way. Two years later he became assistant engineer of surveys.

HARRY A. LANE

Obituary

James Forrest, for many years secretary, and for the last twenty years honorary secretary, of the Institution of Civil Engineers, London, died Mar. 1. Save for two short breaks, one for three years and the other for four years, Mr. Forrest devoted practically the whole of his working life to the service of the Institution, for, after his retirement in 1896, he continued to take the keenest interest in all its doings. Mr. Forrest at the early age of sixteen entered the firm of Edward and John Manby, civil engineers, Westminster, as articled pupil. It was this step which, indirectly, brought him into touch with the Institution, for one of his employers was secretary of that body. It was here that his association with the Institution began which lasted for nearly three-quarters of a century and which resulted in the Institution being conducted on a business basis, the foundation of student classes and the amalgamation of the society branches.

William Henry Hunter, M. Am. Soc. C. E., M. Inst. C. E., formerly chief engineer and since 1910 consulting engineer to the Manchester Ship Canal Co., died on Feb. 27 in Cheshire, England. He was born in 1849, was educated at the College of Physical Science, Newcastle-on-Tyne, and served five years in the works of Thomas Meik. His connection with the Manchester Ship Canal began in 1882, and five years later he became principal assistant engineer under Leader Williams, the engineer-in-chief, and Mr. Abernathy, consulting engineer. In that capacity he was directly concerned in the design and execution of the whole work from Eastham to Manchester. In 1895 he was appointed chief engineer, which position he held for 15 years, becoming consulting engineer in 1910.

S. C. Long, general manager of the Pennsylvania R.R., died Mar. 25. Like so many of the operating officials of this road, Mr. Long was an engineer and had been in the service of the Pennsylvania R.R. for practically his entire adult life. He was born in 1857 and was graduated from Lafayette College in 1877. For three years he was in the employ of various coal-mining companies in Pennsylvania and for another year was with the Philadelphia & Reading Ry. He entered the service of the Pennsylvania in 1881 as rodman on construction work. The next year he was promoted to transitman, the following year to assistant supervisor, in 1885 to supervisor and in 1889 to assistant engineer. In 1901 he was made superintendent of the Bedford division, and in the subsequent years prior to his promotion in 1907 to general superintendent of the western Pennsylvania division he was transferred to other divisions. In 1911 he was made general manager of the lines east of Pittsburgh and Erie.

New York Subway Labor Given Wage Increase

Public Works Contractors Appoint Military Committee To Facilitate Construction of New Subways

That public work in New York City would be affected by active preparations for war is a possibility taken into account by both the city and contractors for work under way. The difficulty of holding men, and intimations that labor troubles would revive on the subway work, appear to be back of an increase in wages granted to the subway workers on Mar. 31. The new wage scale is said to be $3 a day for timber men, $2.40 for laborers, and $4 a day for drillers; and to involve an increase of $1,000,000 in the annual pay-roll on the subway construction

The city administration has suggested, in case a large supply of labor is needed to construct fortifications in the vicinity of New York, closing down other municipal work and perhaps some private work in the city, so that the additional labor required could be found without causing serious delay to rapid transit construction. This matter is being considered by a public works mobilization board appointed by the Mayor of New York City, with which is co-operating a military committee appointed by the General Contractors' Association, which includes all the large contractors engaged in public work in the New York territory. The following construction firms are represented on the contractors' committee: F. L. Cranford, Inc., the Holbrook, Cabot & Rollins Corporation, Patrick McGovern & Co., the Borough Asphalt Co., the Moran Towing and Transportation Co., the Terry & Tench Co., Inc., the Beaver Engineering and Contracting Co., the Northeastern Construction Co., and the Lord Electric Co.

Dayton Reports Reduced Costs

What is characterized as a "high spot" report on achievements under the commission-manager plan of city government at Dayton, Ohio, has been issued by the Dayton Bureau of Research, of which C. E. Rightor is director. Presumably those interested in all the details can get a copy of the statement by asking for it. A section of the report follows:

In the department of service the eight-hour day was inaugurated, and wages were advanced 25 to 37½%. In spite of this increase, twice as much work was done in 1916 and at one-half the cost as in the days of politics. Asphalt repair that used to cost $1.65 per sq.yd. now costs only 65c.; street flushing formerly cost $12.72 per mile, and now it is being done for $2. The price for street oiling was reduced 40%. Garbage collection that cost $2.60 per ton is being done for a dollar less; garbage collections have been doubled and wagons are covering nearly twice as many miles per day as they did under political rule. Through the building of a municipal reduction plant, at a cost of $59,000, domestic waste in 1916 yielded an income of $10,000 as against a former annual charge of approximately $52,000. Although running only one year, the plant has paid a profit over and above all expenses and charges.

General Advance in Cement Throughout Country

Further Great Gains Also in Steel Products—Factors of Uncertainty in Present Situation—Labor Question Becomes More Serious

A general advance in the price of portland cement, ranging from 10 to 25 cents, has occurred recently throughout the entire country. Accompanied by further increases in the price of steel products, which brought quotations for structural material up to $3.75 Pittsburgh, this movement indicates that an active demand for construction materials was anticipated by all concerned at the time the price advance was made. The entry of the United States into the war, however, would bring a number of new factors into the situation which cannot be gaged accurately as yet. Should the war prove a long one, it might become a drain on the resources of this country in the end, while in the near future activity would be stimulated and prices might be expected to rise. On the other hand, if efficient centralized bureaus for handling and distributing products should be established, in the course of a few months, because of the war, prices might remain stationary or recede. Such action, however, would doubtless be preceded by curtailment of all construction work which was not absolutely needed, both because of the labor shortage and because the money would be necessary for carrying on the war. Such a curtailment would in itself operate to lower prices for construction materials which are used locally and do not find a market in other fields. On the other hand, the view is still expressed by many that the entrance of the United States into the war means an early, and perhaps an unexpectedly early, peace.

Labor Shortage Inevitable

It is believed that the entrance of this country into the European War will mean a still more serious shortage of construction labor, much greater difficulty in selling bonds to finance public works, a possible continuance of industrial expansion, and the carrying out of an unusual amount of construction, especially on the Atlantic seaboard, by the Federal Government. The raising of a large army, the possible internment of foreign residents and the increase in some lines of manufacturing will all tend to make the labor situation more serious. While money has so far been plentiful, and only recently did the market for bonds begin to decline, the demand for funds to carry on the war will probably absorb within a short time most of the surplus accumulated during the past two and a half years. Therefore, public construction work which has not yet been financed may be subject to delay.

Indeed, these possibilities are already being considered in New York City, where the contractors on subway and other public work have offered to divert their forces to Government construction at cost. Moreover, a committee of the General Contractors' Association of that city has been appointed to co-operate with the civil administration in carrying out necessary defense construction and avoiding delays in completing the new subway system. Scarcity of men and threatened loss of labor to other fields have furthermore compelled the subway contractors in New York City to grant wage increases aggregating $1,000,000 a year. The United States Steel Corporation, also, has just granted its employees another 10 per cent. wage increase.

With regard to public work for national defense, a foretaste of what may materialize in this direction is given in the work already provided for by the naval appropriation bill, recently approved, which includes among other items of construction work the following more important ones:

Navy yard, Portsmouth, N. H., improvements and extensions, $134,000.

Navy yard, Boston, Mass., improvements to power plant, $150,000, and other improvements, $97,500.

Navy yard, New York City, storage facilities and machine shop extension, $900,000, dredging $125,000, other improvements $194,000.

Navy yard, Philadelphia, Penn., continuation of dry dock construction, $1,000,000, power plant improvements and locomotive crane, $220,000.

Navy yard, Washington, D. C., gun shop, $900,000 (advertised), power plant improvements $772,000, other improvements, $56,000.

Navy yard, Norfolk, Va., continuation of dry dock and structural shop under construction, $1,600,000, waterfront improvements, $500,000, power plant improvements, $300,000.

Naval Academy, building construction, $2,270,000, power plant improvements, $300,000.

Navy yard, Charleston, S. C., pier superstructure, $500,000, other improvements, $195,000.

Naval flying station, Pensacola, Fla., $235,000.

Navy yard, Mare Island, completion of floating crane, $450,000, other improvements, $155,000.

Navy yard, Puget Sound, Wash., power plant improvements, $100,000, storage facilities, $500,000.

Naval Station, Pearl Harbor, H. I., completion of dry dock, $936,500, store house, $100,000.